A descriptive catalogue of manufactures from native woods

Charles Richards Dodge

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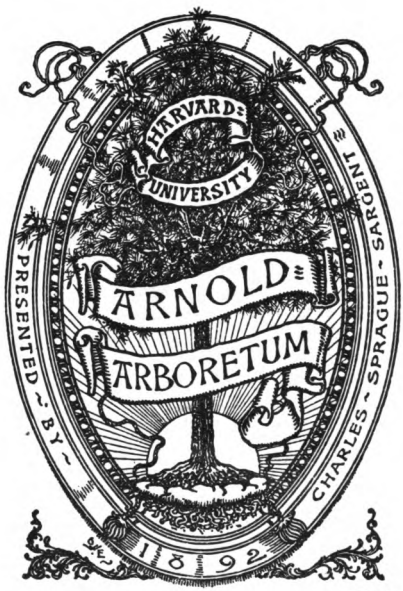

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DEPARTMENT OF AGRICULTURE.

MISCELLANEOUS. SPECIAL REPORT No. 10.

A DESCRIPTIVE CATALOGUE

OF

MANUFACTURES FROM NATIVE WOODS,

AS SHOWN IN THE EXHIBIT OF THE

U. S. DEPARTMENT OF AGRICULTURE

AT THE

WORLD'S INDUSTRIAL AND COTTON EXPOSITION AT NEW ORLEANS, LA.

BY

CHARLES RICHARDS DODGE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1886.

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LETTERS OF TRANSMITTAL.

DEPARTMENT OF AGRICULTURE,
Washington, D. C., May 14, 1886.

SIR: I have the honor to transmit herewith, for approval and for publication, a report on "Uses of American Woods," based upon materials and information collected by this Department in connection with its exhibit at the World's Industrial and Cotton Centennial Exposition, New Orleans.

The interest in the collection was so manifest and practical that it was deemed advisable to make an investigation by special interrogatories addressed to manufacturers and others relative to the practical uses of woods in their own experience, the results of which are printed below, in the report of Mr. Charles Richards Dodge, who was authorized to conduct the inquiry.

I have the honor to be, very respectfully, your obedient servant,

WILLIAM SAUNDERS,
Representative of the Department of Agriculture at the Exposition, New Orleans.

Hon. NORMAN J. COLMAN,
Commissioner of Agriculture.

BOSTON, MASS., *January* 30, 1886.

SIR: I have the honor to transmit herewith, for publication, a descriptive catalogue of manufactures from native woods, which form a portion of the exhibit of the United States Department of Agriculture at the New Orleans Exposition. Appended to this catalogue will be found some facts and figures relating to wood-manufacturing industries, which, with the opinions of prominent manufacturers regarding the future supply of timber for manufacturing purposes, it is hoped will add something of value to the literature of economic forestry.

I remain, very respectfully,

CHARLES RICHARDS DODGE.

WILLIAM SAUNDERS, Esq.,
Representative of the United States Department of Agriculture at the World's Industrial and Cotton Centennial Exposition, New Orleans.

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USES OF AMERICAN WOODS.

INTRODUCTORY.

One of the most interesting collections in that portion of the New Orleans World's Fair known as the Government building was the exhibit of the Department of Agriculture, showing the uses of American woods, which was chiefly made up of manufactured articles in all stages of manufacture representing the wood-working industries of the United States.

At the outset it was thought that such a collection would at least prove a novelty, and perhaps serve to call the attention of many people to the importance of the subject of forest protection who had hitherto given it little thought or care; but as the work progressed and the manufacturers became interested to the extent of preparing and donating many valuable exhibits illustrating prominent industries, it became evident that the collection would prove a useful aid in the study of the forestry question from the economic stand-point.

The future timber supply of the country is a grave question that before many years will demand the urgent consideration of many who now affect to regard it most lightly. In view of the immense annual destruction of valuable timber, through carelessness and ignorance, or worse, indifference, it was thought desirable to obtain some knowledge of the extent and value of our timber resources and the legitimate demand that is made upon them by wood-working industries. To this end a circular letter was sent to many hundreds of manufacturers with a view to learning what woods are most commonly used, chief resources of supply, value of lumber for different uses, wastage, processes of manufacture, opinions as to future supply, &c. Few manufacturers would give the time for a full consideration of the subject in all its economic bearings, but a sufficient number of intelligent and thoughtful answers were received to show that while, on the one hand, our wood manufacturing industries are rapidly using up the best timber growth in the country, on the other, wise legislation and a proper education of the people to the necessity of keeping up the old, or producing new forest growth, will ultimately result in restoring and preserving a balance, especially with regard to the more valuable kinds of hard wood.

Many interesting facts are stated regarding the quality of wood used, or the particular parts of the tree required for the manufacture of certain articles, the various stages of manufacture, extent of special in-

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dustries, &c. It is thought that an interesting study may be made of the facts relating to sources of supply, but in the greater number of cases "home supply" is stated as the chief dependence, though sometimes the more valuable woods are brought long distances.

The attempt at economic classification is only provisional. At some future date, when the present collection has been augmented and made more fully complete, a better classification of the uses of woods in manufacture may be suggested. Until that time the present will suffice.

CLASSIFICATION.

I.—In architecture and building.
II.—In transportation.
III.—In the manufacture of implements of industry.
IV.—In articles relating to trade.
V.—In articles for man's physical comfort.
VI.—In articles for education, culture, or recreation.
VII.—In miscellaneous uses not included in the foregoing.

I.—USES OF WOODS IN ARCHITECTURE AND BUILDING.

The building industry is probably the most universal of all human industries which make a demand upon the forest supply, though this demand relates mainly to the softer and less expensive woods. As the term "building" is understood to embrace all framed structures, for habitation or storage, from a fisherman's hut to a five-story hotel or a grain elevator, so are included in this category not only every kind of building that may employ wood in its construction, but stationary structures such as bridges and trestles, and intimately connected with them the raising of derricks and scaffolding, and fencing. The construction of railway and telegraph lines also finds a place in this group, which is illustrated by the following synoptical table of arrangement:

A.—HOUSE BUILDING: Including all kinds of architectural structures. *Frame:* Sills spruce, pine, chestnut, and cypress; posts, plates, braces, joists, studding, &c., white and yellow pine, spruce, hemlock, and other woods. *Outside finish:* Sheathing of pine, spruce, hemlock, or other woods; clap-boards, pine, spruce, and cedar; roofing-boards, same as sheathing; shingles, white and yellow pine, cypress, spruce, oak, &c.; sash and blinds, pine, usually; cornice-brackets, pine, whitewood, &c. *Interior finish:* Laths, spruce, pine (white and yellow), and other woods; moldings, pine, whitewood, and hard wood according to taste; panelling the same; door and window casings, pine and hard woods; doors, mantels, wainscoting, &c., in various woods, though chiefly pine; stair-rails, balusters, newel posts, whitewood, ash, cherry, oak, and other woods. On the Pacific coast redwood is used largely in house building.

B.—BRIDGE AND TRESTLE CONSTRUCTION: Bridges, trestles, derricks, scaffolding, shafts and coffer-dams. Piles of spruce or pine; girders, stringers, beams, planking, &c, spruce, white and yellow pine, and sometimes hard woods; other timber as in house building; staging poles, pine, spruce, &c.

C.—CONSTRUCTION OF RAILWAY AND TELEGRAPH LINES: Ties, switch-frames, signal-boxes, fencing-posts, &c.

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A.—HOUSE BUILDING.

Beams, joists, and board lumber. (Not shown.)

Laths and shingles.

Shingles of Michigan white pine, from C. C. Comstock, Grand Rapids; yellow pine, Northrup & Cumming, Wilmington, N. C.; cypress (same firm), hand-made, by negroes in the Dismal Swamp, in sizes as follows: 4 by 18, 5 by 20, 6 by 20, and 7 by 20 inches. Cypress shingles are also exhibited from Gurley & Bro., Norfolk, Va., and A. C. Danner, Mobile, Ala.

All qualities of lumber are used for shingles, cut at all seasons of the year. Spruce and balsam fir are largely used in Vermont. In Pennsylvania, pine and hemlock for shingles are cut at all seasons, though suitable lumber is growing quite scarce in many parts of the State. In North Carolina the pine lumber is cut in fall and winter, both heart and sap being used, though the cypress is usually cut in the summer months. In the Gulf States, cypress is considered one of the most valuable and durable of woods, not only for shingles, but for other portions of buildings where subjected to extreme dampness. It is also used for door-posts, window-frames, gutters, weather-boarding, &c. Outside of house building, its uses are manifold, as it is employed in vessels, rail-cars, cooperage, boxing, and even for nice interior finish. Drawn or hand-made cypress shingles are usually made 18 inches long, in width of from 3 to 8 inches, and put up in four bunches to the 1,000, by measurement, 4 inches in breadth counting as one shingle. In a Vermont shingle-mill the timber goes through the following processes: (1) Logs are bolted up into 18-inch blocks; (2) the bark is removed; (3) the bolts are placed in shingle-machine, which is self-feeding: (4) taken from the saws to the jointer; (5) the shingles are packed in quarter-thousand bundles. The labor represents about 75 per cent. of the total cost.

Sash and blinds.

Only a few examples of this manufacture are shown. Estate of James Turner, Mobile, Ala., donated specimens in yellow pine. William H. Pierson, Wilmington, Del., sent blinds in white pine.

In selecting lumber for this use, as well as for doors, only that portion is taken clearest of sap-wood, knots, and heart.

Doors.

Plain white-pine doors, W. H. Pierson, donor, Wilmington, Del. Exhibits of panels were received as follows: Decorated pine panels, M. P. Mason, Carthage, N. Y.; "curled pine," very handsome examples, Northrup & Cumming, Wilmington, N. C.; panels of pine, walnut, "curly maple," white birch, white ash, and cherry from A. C. Vogler, Salem, N. C.

While every known hard or soft wood is used in manufacturing doors, in one form or another, the principal woods employed are white and yellow pine, and whitewood or poplar, the best of lumber being requisite.

In making an ordinary beveled door the principal machines are, first, the double surfacer or planer, rip and crosscut saws; the material for sash and doors, after being planed, is then ripped or sawed to the required widths, afterwards cross-cut for the length, going next to the

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mortise-machine or tenoning-machine, as some parts have to be both mortised and tenoned, while others need but the one operation; next through the molding-machine, which takes the pieces to the required width and at the same time grooves and molds the edge; then put together and placed in the drying-kiln, subject to a temperature of 150 degrees for three or more days, according to the previous state of the material; then ready to be glued and clamped together, after which it is planed, smoothed on both sides either by a planer or hand-plane; then to the sand-papering-machine, and it is ready for sale. In making panel doors, after leaving the saws, the material goes to the panel-raiser, which works a molding around the two sides. There are a number of other machines, such as the band-saw, scroll-saw, boring-machine, shaper, turning-lathe, tenon-machine, &c. A fine sliding or folding door, in hardwood finish, requires different handling, however. The stiles and rails are glued up from common pine strips thoroughly kiln-dried, faced to the thickness of one-half inch less than the intended thickness of the door. They are then covered or lipped with such hard-wood as specified and then represent hard-wood stiles or rails, which are now properly mortised or dovetailed together and the panels filled in with the same or other hard wood in the solid as desired. The moldings are now mitered and glued around the panels on each side of the door, after which everything is nicely cleaned off and sandpapered, and the door is now ready for the polisher. The component parts of a door pass through several machines before they can go together, such as a surfacer worth $800, saws $50, jointer $200, molding machine, $500, mortising or boring machine, either worth about $125, sandpaperer, $550, besides other machines.

Door knobs.

In black ash, black walnut (Ohio and Indiana), white birch, cherry, elm, "curly maple," oak, and apple. Presented by the Union Door-Knob Company, Detroit, Mich. These articles are manufactured from knots or gnarled roots, the wood being purchased by the pound, the wastage amounting to 75 per cent.

Gutters, or eaves-troughs.

Water-conductors in cypress. Also one sample of "anti-freezing and non-bursting eaves-trough," from U. F. Moulton, Burlington, Vt.

Cornice-brackets.

A series in carved or scroll-saw designs, from pine and poplar lumber, presented by Palmer, Fuller & Co., Chicago, Ill.

Flooring, plain.

Example of across-the-grain patent yellow-pine flooring from New Haven Steam Saw-Mill Company; no description accompanying.

Dressed and matched flooring in yellow pine is usually classified as clear flooring, heart on the face side, and free from all defects; first and seconds free from all knots, shakes, and "blue," but may contain all the bright sap; standard flooring 50 per cent. of first and seconds; 50 per cent. of common, and common flooring of sound timber, though it may

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have knots or other defects, but not to be badly "blued." In sawing flooring strips three grades are usually made: clear rough strips that shall be all heart, with one side free from defects; first and second strips that are free from knots and shakes, but shall contain all the bright sap; standard, 50 per cent. of first and second and 50 per cent. of common, containing no blue that planer will not remove. In measuring, flooring strips and boards run from 3 to 6 inches wide, and are usually sawed an eighth of an inch thicker than wanted, an inch thickness being in reality one and one-eighth inch.

In the New England States white-pine, spruce, and hemlock lumber is used for different kinds of flooring, and to some extent hard woods, though these are described below.

Flooring, ornamental.

There are several beautiful exhibits of parquet flooring in ornamental designs, the handsomest and largest series coming from Messrs. Baker & Benedict, Chicago, Ill. This series embraces all the hard woods in common use. Two panels were also received from William Hannam & Co., New York City. These are chiefly Indiana white oak, though other hard woods are used from the same State and from Michigan.

There are quite a number of manufactories of "parquetry" mosaic floors, wood carpet, &c., where wood ceilings and wainscoting are also turned out in considerable quantity. A single Eastern firm produces annually near 100,000 feet of $\frac{3}{8}$-inch parquet floor, and nearly half as much of $\frac{7}{8}$-flooring, besides 1,000 feet each of wainscoting and ceilings. The woods used are oak, white ash, black walnut, maple (of different kinds), white birch, sycamore, white holly, and cherry, yellow pine being also employed in each part made. Of course only first-quality lumber is used. It should be mentioned, also, that about 10 to 15 per cent. of imported lumber is used, being chiefly red and white mahogany, rosewood, amaranth, tulip, English oak, and ebony. The labor represents about two-thirds of cost, as each article passes through ten hands and twelve to fifteen machines; besides the wood has to be both air and kiln dried, and finished with shellac or wax, or often highly polished.

In wood mosaic, where the blocks are made to sizes $1\frac{3}{4}$, $1\frac{6}{10}$, $1\frac{1}{12}$, &c., and jointed and grooved to form the mosaic, a greater number of operations are necessary, besides the use of special machines. An alternate jointing and grooving machine turns out twelve blocks per minute. After completion the blocks are assembled in various designs, making sections about 16 inches square, held together by lead. Maple and cherry are frequently ebonized, to avoid use of the foreign wood. Sapwood and wood from young growth are always objectionable, the heart and more solid portions always being used in parqueting.

Moldings and interior finish.

A fine series of machine-made moldings in walnut, white oak, white pine, butternut, white wood, gum, and cherry. From Palmer, Fuller & Co., Chicago, Ill., chiefly from first-growth timber. A second series was received from John J. McNutt's Novelty Wood Works, Boston, Mass. The same woods are employed, the examples being very beautifully polished.

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Stair rails and stair balusters.

A large and interesting series of stair rail sections and stair balusters in white ash, cherry, white oak, whitewood, and black walnut are exhibited from Palmer, Fuller & Co., Chicago. A second series was donated by the New York Wood Working Company, 134th street, New York. Balusters in blue ash were sent by Requarth, Hessler & Co., and Purvis Company, New Orleans, La., sent samples in cypress.

Newel posts.

A series in walnut, oak, white ash, and other woods. Palmer, Fuller & Co.

These articles, as well as other manufactures by this firm, are made from lumber obtained in Michigan, Wisconsin, and Indiana chiefly, and largely of first-growth timber.

Pew ends (church interiors).

The same firm contributes a series of six pew ends employing white oak, Michigan birch, Indiana black walnut, ash and black walnut in combination, oak and black walnut, and "calico ash" from Indiana, in combination with cherry.

Weather strips.

In cherry, black walnut, ash, and enameled pine, from S. Roebuck, Fulton street, New York City.

Window screens.

"Dowling's patent adjustable," in walnut, George C. Wetherbee & Co., Detroit, Mich.

B.—Bridge and trestle construction.

This group was not represented. Pine and oak, however, are usually employed in bridge construction, either in combination with iron or alone. Joists and flooring of iron highway bridges are commonly of white oak; used also for ties and guard rails of railroad bridges. Creosoted Southern pine is sometimes used for flooring.

A large bridge-building company states that Michigan white pine, and white pine grown in Pennsylvania are used in Howe truss bridges. The white oak is usually obtained in the locality where the bridge is constructed; can be cut at any season, although the best pine is cut in the winter season. Bridge lumber is in all sizes and lengths, from 6 inches square to 10 by 24 inches, and from 14 to 50 feet long.

It is estimated that there are some sixty bridge-building companies or firms in the United States at the present time, employing a large number of men, and with an invested capital of $8,000,000 to $12,000,000. It is difficult to get at the average of prices for bridge lumber. As near as we can estimate, white oak ranges from $12 to $25 per M according to locality; white pine, varying according to length, ranges from $16 to $24.

C.—Construction of railway and telegraph lines.

Railroad ties.

These were not represented, save by one example of creosoted yellow-pine tie, from Northrup & Cumming, Wilmington, N. C.

Professor Sargent states that the railroads of the United States, old and new, consume every year not far from 60,000,000 ties, representing

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a destruction of 30,000,000 vigorous, healthy young trees; that is, upon the supposition that two ties are cut from a tree. This shows a drain upon the forest wealth of the country "that should cause grave apprehensions for the future, especially in view of the fact that in every part of the country there are now growing fewer seedling trees of species valuable for railway ties than when the trees now cut for this purpose first started."

The value of railroad ties put down by completed roads in 1880, not counting some 10,000 miles of road, amounted to nearly $10,000,000. Ties are made chiefly from oak, hemlock, and red elm.

Fence posts. (See following.)

Telegraph poles. (Not represented.)

These are cut from white cedar, red cedar, white ash, and oak, and sometimes from other woods. It is claimed that Chicago furnishes one-third of all the telegraph poles used in the United States, one-ninth of all the railroad ties, and 5 per cent. of the posts, supplying railroad and telegraph lines from New York State to Utah, southwest as far as Arizona, besides sending some poles to Mexico. Telegraph poles and posts are chiefly made from white cedar. No pine is used for poles. Beside railway uses, posts are used for fencing and street paving. Average duration of white-cedar posts and poles, eight to ten years. Red cedar, white oak, and burr oak, last longest, in the order named; the latter will probably last twelve years or more. Very little red cedar is used, and it is not stated how long it will last. Much of the white cedar comes from Wisconsin and Michigan, and the hemlock from Canada.

Poles are usually cut in winter, peeled in the spring, and finished at stump; posts and hewn ties also finished at the stump.

A large Chicago dealer in these railroad timber supplies states that there is cedar enough in the country to last one hundred years, but it will be very expensive twenty-five years from now, and that all railroads building west of the Mississippi River should have been forced to set aside for tree culture two sections of land for each 10 miles of railroad built. They should have divided these sections into thirty-two 40-acre pieces, and planted 40 acres of timber to each 10 miles of road each year, taking thirty-two years to get it all in. By the end of twenty-five to thirty years they would have plenty of ties, and at less than half they have to pay for them now in Western Iowa and Minnesota, Kansas, Texas, Nebraska, and Dakota.

It could have been done then at $2.50 per acre. Now, of course, it would cost more; but even now it is the only way out for the railroads, and would also do more than any one thing to put forests in the treeless States, which they want so much.

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Cross-arms.

Cross-arms for telegraph posts in white cedar or juniper, from the Dismal Swamp, Va. Presented by the New York Cedarware Company, 82 Wall street, New York.

Telephone.

Wood-work of fixture, signal buttons for the electric bells, &c. Western Electrical Company, Chicago, Ill.

II.—USES OF WOODS IN TRANSPORTATION.

While this is not so large a division of industries as the preceding, it nevertheless forms a most important group, consuming millions of feet annually of the choicest hard-wood timber that can be obtained, and much of it timber which cannot be replaced. It may be stated in illustration of the importance of the three industries, ship, car, and carriage and wagon building, that the invested capital in 1880 amounted to nearly eighty millions of dollars, and that the annual product, in round numbers, amounted to almost double these figures. The different uses of woods in the construction of, or in connection with, vessels or vehicles for moving mankind or the property of man from place to place are grouped as follows:

A.—SHIP AND BOAT BUILDING: Illustrated by a three-masted ship, as constructed in a New England ship-yard. *Hull:* Keel, white oak, though rock maple, yellow birch, or southern black gum are also employed; keelson, yellow pine, sometimes hard woods; ribs or frame, oak, chestnut, or hackmatack; stem and stern post, white oak; apron (inside of stem), live oak; planking (exterior of frame), white oak or yellow pine; ceiling (interior of frame), yellow pine; transoms and knees, hackmatack and white or red oak—formerly live oak; deck frame, yellow pine; upper deck, white pine; lower deck, yellow pine; rails and all finishing timber, white oak; treenails, with which timbers are doweled together, yellow locust; house or cabin, white pine, whitewood, or fancy hard woods (interiors) according to taste. *Above deck:* Bowsprit and masts, white pine; spars, spruce; steering apparatus—wheel, various hard woods; rudder, oak; rigging parts in wood—tackle blocks, white ash or gum; mast-hoops, oak; dead-eyes, &c., lignum-vitæ; belaying pins, oak or hickory; fids, hickory.

In a "hard-wood frame," as built on the Maine coast, hackmatack is used at the top, on account of its durability, maple, birch, beech, and oak being used below. Smaller vessels are sometimes built throughout of spruce, with some oak, though they remain *prime* only about four years. In small boats and canoes, with their necessary oars, paddles, masts, &c., white and red oak, red elm, pine, white cedar, brown ash, spruce, cherry, walnut, and bass-wood are used.

B.—CAR BUILDING, in which is included railway and street cars, elevator cars, and hoists. Illustrated by a passenger coach as constructed by the New York, New Haven and Hartford Railroad Company. *Bottom:* Side sills, intermediate sills or stringers in southern or yellow pine; end sills of white oak. *Frame:* Door and corner posts, ash, sometimes whitewood; side posts, ash, that of second growth preferred; plates, ash or pine; window sills, ash; car lines or rafters, white oak and ash; dome plate and dome posts, ash. *Exterior:* Paneling, letter-

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board, and moldings, whitewood (as this wood takes paint better, and gives a nicer finish). *Interior:* Doors, mahogany; window frames, cherry; blinds (when used), slats, bass; frame, cherry; seat frames, wood parts, oak; floors in ash, &c.; interior paneling, various fancy native and foreign woods, according to taste; ceilings, usually oak or maple. *Trucks:* Wheel piece and end piece of truck frame, truck bolster, spring beam, spring plank, safety beam, brake beam, brake block, &c., of white oak. There are many other lesser beams and parts connected with platform, or used in frame, or that occur in freight or other cars, but the same woods, relatively, are used, and to name them is unnecessary.

C.—CARRIAGE AND WAGON BUILDING: Includes the building of omnibuses, wagons, coaches, carriages, carts, barrows, and trucks. Illustrated by a carriage as built in New Haven. *Gear:* Axle-bed, head block, perch, side bars, futchells, puncheon, draw bar, &c., light or perch work of hickory, heavy parts of ash. *Draught:* Shafts, pole, and swingletrees, hickory. *Wheels:* Hubs, elm (generally), black birch, locust, oak, and black gum (the latter Middle and Southern States); spokes, hickory or oak; rims, hickory oak or ash. *Body:* Rocker, pillars, bars, top rails, and rafters, ash; paneling, whitewood; bows, usually ash.

D.—HARNESS, WOOD-WORK, &C.: Saddle-trees, oak, poplar, ash, beech, gum, elm, hickory; hames, oak, chiefly, also white ash, white or soft maple, rock elm, and hickory; wood stirrups, white ash, black ash, and hackberry; martingale rings, rock maple; whip-stocks, hickory, holly, and Osage orange.

A.—SHIP AND BOAT BUILDING.

No examples of ship-building timber were shown in the collection of woods exhibited.

Frame timbers.

These are from the best quality, winter-cut oak, usually received in the log, and estimated by the ton of 480 cubic feet. In a vessel of 1,500 tons register, about 600 tons of oak are required in the construction, 400 M yellow pine, and 50 M white pine and decking. Chestnut, birch, maple, beech, and hackmatack frame timbers are also used, the latter coming next to oak in demand.

Knees (chiefly hackmatack or juniper).

They are dug from the roots of the trees, the trunk forming the stock of the knee and the root the arm. They are roughly hewn in the woods, then dressed for market on a rotary planer, the sides only being taken off. Two-thirds of the cost is labor and transportation. Of course one tree furnishes but a single knee, but it is claimed that hackmatack is of rapid growth, twelve years sufficing to make a tree large enough to produce a 6-inch knee. The New England ship-builders use Maine timber chiefly, cut on the Penobscot River and its tributaries, though some comes from Canada. One correspondent estimates that 40,000 knees are annually shipped at Bangor. Knees are rated by their size, a 4-inch knee costing 35 cents; 5-inch, 65 cents; 6-inch, 80 cents; 7-inch, $1.50; 8-inch, $2.50; 9-inch, $3.50; 10-inch, $5; 11-inch, $6; and 12-inch, $7. It is further stated that there has been a decrease of about 15 per cent. in cost in late years, owing to increasing use of iron in ship-building, and increased facilities for railroad transportation.

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Masts and spars (pine and spruce).

Spruce spars are generally cut from Maine timber, though large spruce sticks for heavy spars are imported from Canada. Mast timber for large vessels comes from the Middle States, Pennsylvania, and Maryland; yellow-pine lumber from Georgia. While mast and spar timber is best when cut in the winter, replies show that it is cut at all seasons of the year. A Maine firm, dealing in masts and spars, says, "We seldom send finished sticks out of the States, but frequently send deck-loads of rough or rough-dressed stock to South America upon orders."

Small boats.

Fishing dories and pleasure boats are constructed from oak, pine, cedar, and various hard woods in combination, according to taste of buyers. A Newburyport builder of fishing dories uses second-growth. white pine and old-growth red or yellow oak. The very best quality is used, cut in the winter and allowed to season through the summer "Best cuts for the sides are employed, heart and sap alike; cuts for bottoms, 13 to 20 feet long, of second growth, neither old growth nor sapling.'

Whale-boats employ in construction white and yellow oak, spruce, white pine, white cedar, birch, and maple.

Canoes.

J. H. Rushton, Canton, N. Y., donates a canoe, the Sairy Gamp, together with parts of canoes and similar pleasure craft, in white and red oak, red elm, pine, white cedar, brown ash, spruce, cherry, black walnut, hackmatack, and bass-wood.

Hunt & Morrison, Oldtown, Me., also contributed a birch-bark canoe, frame of cedar, covered with bark of silver birch.

The labor is 50 per cent. of the cost of a sailing canoe. The oak employed in its construction is got out of the plank by circular saw, finished with planer. Hackmatack knees reduced to form with hand-saw, chisel, and mallet, to make sterns and keelson. Siding, barrel resawing machine and planer, rest hand-work; braces and deck-timbers reduced to shape by barrel-saw, finished by hand; deck-work in mahogany all hand-work, as the material is procured proper thickness. All wood is air-seasoned only, from one to three years.

The following description of the building of the birch-bark canoe is appended:

With his materials at hand the canoe-maker first prepares a suitable place for the operation. This is usually a spot having a clayey bed, capable of being flattened into a hard, smooth bottom, sloping gradually from the center each way until, in a distance of half the required length of the canoe, it shows a fall of 4 inches. Sometimes, however, boards are used instead of the clayey bed, sloping them from the center in the same manner. The builder now rifts from a cedar log two rails, 1½ inches square and 15 to 20 feet long, according to the desired length of the canoe. These are fastened securely at the ends and fitted with cross-pieces or thwarts, five in number, which serve the double purpose of strengthening and supporting the canoe and supplying seats for the occupants. The frame is then placed on the ground previously prepared, the center touching the center of the bed and the extremities resting on pegs driven into the ground and rising to a height of 4 inches.

Stakes are then made 1½ to 2 inches in diameter and 3½ feet long, and driven into

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the ground to a depth of 6 inches at the extremities of all the thwarts, and at intervals between them of 14 to 18 inches. These stakes are then pulled up, care being taken that the holes be left clean. The frame is removed, and the long strip of birch bark (usually in one piece) is laid down, the frame put into its old position again, but over the bark, and then weighted with rocks to keep the bark firmly in place. The bark is then cut at intervals, about six times on each side up to the frame, the sides of the bark brought up to the perpendicular and held in position by two more cedar rails of the length of the canoe and 2 inches wide, which in turn are supported by the stakes now replaced in the old holes. The bark, which previously to bending had been slightly heated at the sides with water to make it pliable, is now allowed to cool, the rocks are removed, and the frame raised up to a height of about 7½ inches at the center, and two pegs of this length are placed under the ends of the center thwarts, which are weighted with rocks, as before. Two more pegs, 2 inches higher than the others, are placed under each of the two next thwarts to the right and left of the center, while the two extreme thwarts are raised to the height of 18 or 19 inches, and held in place by similar pegs. The ends of the bark are now brought up, trimmed in proper shape, and firmly sewed. The sides are trimmed down to the frame, and either sewed or nailed to it. A good coating of tar is then spread on the inside, along the entire length of the bark, which is often supplemented by canvas or strong sheeting. Strips of cedar splints are then got out and placed lengthwise in the bottom of the canoe, forming a complete lining. Ribs of the same material, thick enough to make the canoe firm and steady, are studded in, and a narrow cedar rail is run along the whole length of the top of the frame. The canoe then receives a little stuffing of shavings for a foot or more at each end, to add firmness there and resist pressure, and the shavings hidden from sight by a light cedar partition.

More or less scraping and carving follow, and then the canoe is complete, save for a coating of tar on the outside, where the necessary cuttings had made a few breaks. If more finish and completeness is desired shellac or varnish is applied, and if the maker has succeeded in his work, you will have a light, graceful craft, easy to propel, capable of carrying a heavy load, and though a trifle coy and skittish at first, to the unaccustomed, it soon becomes tractable and a source of great satisfaction to the possessor.

Regarding the little canoe, the Sairy Gamp, Mr. Rushton makes the following statements:

It was built for Mr. George W. Sears (better known as "Nessmak"), of Wellsborough, Pa. Mr. Sears is over sixty years old, weighs about one 100 pounds, and is a veteran backwoodsman and a very pleasant writer on woodcraft. He took this canoe—9 feet long, 24 inches beam, 8 inches deep amidship, weighing but 10½ pounds—at Lowville, N. Y.; cruised to Paul Smith's, 118 miles; back by another route, 143 miles. The boat was tight and perfect, and weighed but 10 pounds and 11 ounces. It was then sent to Forest and Stream office, where it remained a year, being used upon occasion to hold water, in which model or miniature yachts were floated; a severe test, by the way, as it might stand weeks in a warm room empty, then be filled with water for a few hours, &c.

Oars, paddles, &c.

Examples of oar-stock in white ash, with oars in various stages of manufacture. Hinckley Brothers & Co., Boston, Mass.

Oars, paddles, and oar-stock in spruce and white ash, J. H. Rushton, Canton, N. Y.

In the manufacture of oars the logs are first cut by a large circular saw; then molded by patterns, and sawed again by a small saw into rafters; then turned out by a lathe into unfinished, the finishing (planing, &c.) being accomplished by hand.

There are probably a score of factories in the United States manu-

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facturing this class of goods. A Bangor (Maine) firm consumes eighty to one hundred thousand feet of lumber annually in this industry, the very best quality of ash and spruce being required. Average cost of lumber, in the log, $15 to $18 per thousand feet.

Tackle-blocks.

Large ship block in white ash sent by Bagnall & Loud, Boston, Mass. Another collection of six blocks in various styles and sizes was received from the Detroit Block Works, Detroit, Mich.

It is estimated there are something like twenty establishments in this country engaged in the manufacture of this kind of merchandise, employing about 300 men and a capital of $375,000. Twelve manufactories have lately formed an association representing seven-eighths of all the blocks made in the country. The "shell" of a tackle-block, while seeming to be fashioned from one piece or solid block of wood, is in reality composed of a number of pieces sawed into proper lengths for sides and ends, and clamped, bolted, or riveted together. The different processes are thus described:

Saw lumber into right lengths and widths, then bore rivet-holes by machine, then pass to shaving-machine and make the curve on outside pieces, then cut slot, if for iron strap; then put together with end pieces, and rivet them together; then saw into shape on band-saw; then pass to scoring-machine, and take out ends; then to sand-belt machine, and finish. Afterwards fit iron straps, if intended for inside iron straps; then drill through wood and iron for pin-hole; then fit sheaves, put in stud-pin, and fit a cap of zinc overhead, stamp each block with letter so as to determine whether it is iron bushed, patent roller bushed, or metalline bushed; then clean up shell, and oil and shellac wood, and you have the complete block ready for the market. The iron straps, if intended for marine use, are galvanized. If for land use are blacked over, using asphaltum.

First quality of second-growth ash is generally used, cut in the winter season. Wood from New Hampshire, New York, Michigan, Indiana, Ohio, Kentucky, Tennessee, North Carolina, and Mississippi. The Southern ash is considered superior to that grown in the Northern States for this use, and is more plentiful. Lumber varies in price from $25 to $50 per 1,000 feet, first quality Western ash costing in Boston $38; purchased in plank 8 to 16 inches in width and 1¼ to 2½ inches thick. Lignum-vitæ wood is used for the sheaves (or wheels), one New England firm consuming 300 tons annually for this purpose. There is a very large export trade of this class of merchandise, American "blocks" being sent to England, South America, East and West India Islands, and even to Africa and Australia.

Rudder.

One finely finished ash rudder, from S. F. Bannar, Wilmington, Del.

Sailmaker's fids.

One set from W. W. Gillette, Bozrahville, Conn.

Fids as used by shipriggers and sailmakers are of two kinds, viz, hand-fids and set or cringle fids. The former are about 18 inches long

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and about 2 inches diameter at the large end, which is rounded to fit the palm of the hand. The other end is brought to a point. They are made of best second-growth hickory, or other hard, close-grained wood, and are used for opening the strands of rope in splicing, also for setting grommets in sails, &c. The set or cringle fids are of similar shape, except that the large end is cut square off to stand upon the floor. They are, however, much larger than the hand-fids, being from 30 to 40 inches or more in length and from 4 to 8 inches in diameter. They are used for setting thimbles in rope, &c.

B.—Car building.

Beams.

Brake beam, in Connecticut white oak. Presented by New York, New Haven and Hartford Railroad Company, from the company's shops at New Haven.

Panels.

One complete smoking-car panel, in section from floor to ceiling, white ash and cherry. Ceiling panels in maple and white oak, beautifully finished; cherry window-frame. Presented by the New York, New Haven and Hartford Railroad Company, from shops at New Haven. Finely finished panels in curled Southern pine, from North Carolina Car Company, Raleigh.

The following are the principal woods used in car construction, with the States from which the larger portion of the lumber supply is drawn:

Oak: Michigan, Ohio, Pennsylvania, Virginia, Connecticut.
Ash: New York, Pennsylvania, Ohio, Michigan, Indiana.
Poplar (whitewood): Ohio, Indiana, Michigan, Kentucky, Tennessee.
Bass (linden): New York, Pennsylvania.
Cherry: New York, Pennsylvania, Ohio, Indiana.
Maple: Ohio, Michigan, Indiana.
White pine: Michigan.
Yellow pine: Southern States.

Only prime quality is used, chiefly winter cut, the prices averaging: Oak, $40 to $50 per thousand; ash, $35 to $45; poplar, $30 to $45; white pine, $20; yellow pine, $40. The various processes for preparing lumber for use cover a number of years. A large manufactory in New York City illustrates this as follows:

Order for lumber in the fall season; cutting logs in winter; sawing and delivering lumber the following year; yarding lumber for air-drying two to three years; cutting to shape and approximate sizes; drying in warm rooms (about 125° Fahr.); dressing lumber to exact forms and sizes; storehoused for use as needed.

C.—Carriage and wagon building.

Running parts.

One carriage part (running part) of landau or coach, showing the progress of manufacture from the rough lumber to the finished part, and ready for the smith, W. G. Shepard & Co., New Haven, Conn.

Hickory side bars, white ash sulky axle beds, S. N. Brown & Co., Dayton, Ohio.

Hickory spring bars for light wagons, William C. Cramer, Philadelphia, Pa.

Brake block, in white oak, G. Lengert & Sons, Philadelphia, Pa.

The running parts of carriages and similar vehicles are chiefly bent work, best second-growth white ash or hickory being used. The pieces,

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after having been sawed (sometimes planed) to the right dimensions, are steamed from one to ten hours, according to size and character of timber; they are then bent upon forms, under pressure, where they remain as long as they were steaming. After having been given their approximate shape, as for a corner post, they are faced on the planer, finished, and are then ready to be packed for shipment to the carriage manufacturer. Mr. Shepard, of New Haven, who donated a full series of these manufactures, has succeeded in bending 4 by 2 inch white ash into links in perfect circles, 12 to 15 inches in diameter, the ends fitting to a nicety, and the whole forming a short chain. He also succeeded in completely rolling up upon itself a stick of heavy white ash 4 by 2 inches and 12 feet long, forming what he has called in his catalogue of donations an "evolute."

Very best hickory for the purpose of carriage bent work is worth about $100 per thousand feet, and ash three-fifths this figure. Hickory should not be used for carriage bodies, unless it has been cut one and a half years, and even two years is better. The Connecticut carriage-makers are still able to get choice hickory grown within the borders of the State, though the supply is rapidly diminishing, with a prospect of failure altogether at no remote period.

Poles and shafts.

Coach and buggy poles in hickory, buggy shafts in hickory and white ash, S. N. Brown & Co., Dayton, Ohio. Hickory swingle-trees, G. Lengert & Sons. White-oak swingle-tree, H. Rademaker, Grand Rapids, Mich. Finished coupé shafts in hickory, W. G. Shepard & Co., New Haven, Conn.

Poles and shafts are usually bent to form, in the same manner as the preceding, the same woods being used.

Body parts.

Coach panel in whitewood, H. Killam & Co., New Haven. This sample is 34 inches in width, though they are sometimes 36 inches, or larger. Section of wagon bed in whitewood and basswood, from Pennsylvania, G. Langert & Sons, Philadelphia.

White poplar or whitewood is the principal wood used in all kinds of carriage panel work on account of its peculiar fitness, as well as great width; basswood panel stock is also employed to some extent. This is worked out of the log (circular cut) in long sheets, the process being patented. The Ranger Bros., East Wilton, Me., thus describe the process: "First, the logs are cut up into 3 and 4 feet lengths or bolts, put into large box, and steamed until they are in the proper state to be cut into the desired boards or panels; then they are first put into the cutting-machine, weighing 3 tons. The knife is 52 inches long, 1 foot wide, seven-eighths of an inch thick. The log revolves until it is cut up to within 7 inches, and this is left, being the heart. The board runs off on a table, sometimes in one whole sheet, 75 feet wide, perfectly whole and smooth, and even in thickness. Two thousand feet of logs are cut into boards of this description.

In three or four hours after the cutting the sheets are again cut into

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different sizes for panels, and put into piles with 2-inch sticks between each board, and allowed to remain until perfectly dry. The bass-wood lumber is obtained in Maine. Other woods, as yellow birch, brown ash, and poplar are sometimes cut in this manner for veneering, sheathing, &c., and for paneling in houses, where it is desired to show natural woods. The various uses are stated as follows: Sleigh and carriage panels, dashers, carriage-top sheathing (one-eighth and one-fourth inch thickness), cloth-boards, drawer-bottoms, picture-frame and mirror backing, and house finish, as above.

Seats.

Sulky seat in white ash, S. N. Brown & Co., Dayton, Ohio. One T-cart seat rail, W. G. Shepard & Co., New Haven, Conn.

Bows.

Buggy and socket bows in ash, S. N. Brown & Co. The same, Donges & Co., Hamilton, Ohio.

Hubs.

Elm hubs and wood in the rough, from the New Haven Wheel Company, New Haven, Conn. The same, S. N. Brown & Co., Dayton, Ohio. The same, John Buckley Spoke and Wheel Company. Hubs, John Donges & Co., Hamilton, Ohio, and George B. Keim, Philadelphia. Gum coach hubs, Howard M. Du Bois.

Spokes.

Heavy spokes in oak and hickory, woods from Atlantic States, New York to North Carolina, and from Ohio and Pennsylvania; John Buckley, Spoke and Wheel Company, Philadelphia, Pa. Carriage and general spoke work in oak and hickory from second growth timber, New Haven Wheel Company. Spokes from Pennsylvania hickory (second growth), G. Wenzler, Philadelphia, Pa. White oak and hickory spokes, from C. C. Andrews, Galion, Ohio; S. N. Brown & Co., Dayton, Ohio; John Donges & Co., Hamilton, Ohio, and Burlington (Iowa) Spoke Company. Heavy oak spokes, P. Roscoe, Windsor, N. C.

Rims or felloes.

Oak and hickory rims in various stages of manufacture from rough timber to finished work, from New Haven Wheel Company. Rims in oak and hickory from S. N. Brown & Co., Donges & Co., and H. M. Du Bois.

Wheels (completed).

Light carriage wheel (American wheel), from the New Haven Wheel Company, New Haven, Conn. Pair of wheels, C. C. Anderson, Galion, Ohio. Patent wheel, H. Rademaker, Grand Rapids, Mich.

The following interesting description of the various processes in the manufacture of a carriage wheel is given by Mr. E. E. Bradley, secretary of the New Haven Wheel Company:

The processes the different parts of a wheel passes through are many and varied, and though they do not pass through them all at the time the wheel is made, it will perhaps be well to state the successive stages from the tree to the finished article. Ordinary styles of wheels are made up of three main parts; as hubs, spokes, and rims, and as each part passes through dissimilar processes, I will describe each in order:

Hubs.—Tough young elm trees of about 8 inches diameter through the butt, and usually of the variety known as white or rock elm, are cut down in the fall, after the

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sap has been expended in perfecting the tree for the season. About 8 feet of the butt is then cut off and taken to the wheel factory. There it is cut up into lengths of about 9 inches—an 8-foot butt usually making about ten blocks. The bark is then roughed off from these pieces, a hole bored from end to end through the heart, then put into a steam box and steamed for two hours. After being taken out and dried off some, the ends are painted or dipped in a preparation to exclude the air, and so prevent checking, when they are laid away in a dark room to pass the trying part of the seasoning process, viz, the first six or eight months, during which they will stand but very little air or light without checking or splitting, later they will stand a good deal of both; at the end of one year, more or less, they are taken back into the factory, the center hole reamed out larger, outside surface turned off to size, ends cut off to length, repainted and put in drying-rooms, thoroughly dried for two or three weeks, then taken to turning rooms, put in lathes and turned to any desired size and style, oiled over, and in a day or two taken to mortising-machines and mortised for proper sized spoke, after which they go to chipping-machines, where mortises are chipped out so shoulders of spokes will fit down snugly into surface of hub. The hubs are now ready for spokes to be driven into them.

Spokes.—Tough young hickory or oak trees are selected and cut down in the fall of the year, the butts sawed off at spoke lengths, say 26 to 30 inches, a 9-foot-length butt making about four spoke-lengths. These lengths are then split lengthwise with the grain into right sizes for the average run of spokes, the bark is taken off, and they are then taken to the wheel factory, piled up under cover where they can have plenty of ventilation for six or eight months, then the ends are sawed off to get to solid wood (for ends will check some in seasoning), also to bring the pieces to required length for turning; then they are turned into the shape and size of spoke desired; after this they are piled in racks for a few weeks, then taken to the different machines and rough-belted, throated, faced, tapered, fine-belted, and tenoned at lower or hub end, then placed in a warm room and kept a few days so that no dampness is left in them, then taken to a sizing-machine where tenons are all tested for size to see that all are alike. Scratch-cutters are used on the tenons to give them a rough glue-holding surface, the ends of tenons are then clampered a little so they will readily enter the hub-mortise. The spoke is now ready to go to its appropriate hub.

Rims.—Tough, good-sized hickory or oak trees that are straight and free as may be from knots, winds, and other imperfections, are selected and cut down in autumn, then 7 to 9 feet of lower part of the butt is cut off and shipped to the saw-mill, where it is sawed from end to end into plank of desired thicknesses—say 1¼ inch to 2½ inch. These planks are then delivered to the wheel factory and piled up, small sticks being placed near each end to keep the planks apart and permit free circulation of air, thereby preventing staining and assisting seasoning. After a few months each plank is sawed lengthwise into strips, which later are cut off so as to be of right lengths to make rims of heights desired for the wheels, then run through planing-machines, put into steam-boxes, steamed until they will readily bend into half circles without breaking, and then put on bending-machine and bent into form. After remaining on the forms a few hours to set they are raked up in bundles of usually a set (eight pieces) each, and put into drying-rooms for a few weeks until seasoned enough for use; the bundles are then broken open and each rim run through planers to square it up and bring width to right size for the tire, the ends are cut off, and each one marked on to its appropriate wheel; ends are bored for dowels, and holes (mortises) bored at right distances for the outer (rim) tenons of spokes; each rim is then rounded and belted, and is then ready for its place on the wheel.

The wheel.—A set of the parts (hubs, spokes, and rims) described above is now brought together. A hub is placed in a spoke-driving horse; the gauge is set so as to give the wheel the disk required. The spokes are placed with lower ends resting on a warm steam-chest; a steam glue-kettle with glue heated to proper pitch

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and glue-stick in it stands close at hand; so also does the man who is to drive the spokes, with his long-handled mallet and short-handled chisel. First he takes up a spoke and looks it over to see if it is straight and perfect for the work; then he puts glue on its tenon and into the hub mortise with his glue-stick; with his long-handled mallet he now drives the spoke-tenon into the hub-mortise until the shoulder is close to the surface of the hub; then with the chisel cuts into the hub around the spoke shoulders, so that the latter will settle well into the hub surface, and finally drives the spoke home. After the spokes are all driven and glued spots cleaned off, the wheel is taken to a spoke cut-off machine and the spokes cut down to proper length for height of wheel ordered; then to a tenoning-machine, which cuts tenons on the upper ends of the spokes to fit holes bored in the rims; then to a "rimming-horse," where the rims are driven on and dowels put into their ends to hold them evenly together while being finished up by hand and smoothed off; then the wheel is taken to a treading-machine and the tread planed off smoothly for the tire. The quality-mark and maker's name are then stamped on front ends of hubs, and the wheel is ready for the market.

The processes the parts go through from beginning to end average about sixteen each, and in putting together to form the wheel about twelve more, making a total of some sixty operations to produce a finished wheel, ready for ironing and painting. Nearly everything is done by machinery, there being about one hundred and sixty machines that run by steam-power, besides some that do not. Labor represents about 60 per cent. and rough material about 40 per cent. of total cost of the products. The lumber is received mainly from the sea-coast States, beginning with Connecticut and ending with North Carolina for hickory. For white oak and elm Connecticut and Massachusetts chiefly. All timber is cut, as a rule, in the fall and early winter, when it is far more solid and perfect than at any other season.

Mr. Bradley further says:

While there are millions of acres of forest (first growth) hickory and oak, the supply of second growth is limited, and costs at present about three times as much as forest. The latter is used largely in cheap wheels, and wheel parts, but will not satisfy the requirements of good work. For the latter, second growth, which is far tougher and more durable, only will answer, and therefore that should be husbanded. A substitute for hickory hoop-poles (which, besides being used for hooping casks, &c., here, are also exported, I am informed) should be found as soon as possible. The cutting of "baby" hickory trees or saplings, from four to ten years old, should be discouraged, as the second-growth hickory supply is liable to become a serious question in the near future, unless systematic efforts are soon made to prevent waste of what we now have, and to encourage its further propagation and cultivation.

Ohio manufacturers draw the bulk of their supplies from their own or contiguous States; spoke-timber comes from Ohio and Indiana; hub-timber, Ohio, Pennsylvania, and New York; rims, Ohio, Indiana, and Kentucky. Some hubs are manufactured from gum-wood, or sometimes from oak, though elm is most commonly employed.

Miscellaneous.

An "evolute" or piece of white ash timber, 2 by 4 inches, rolled into a complete spiral, as an example of difficult bending, W. G. Shepard & Co., New Haven, Conn.

One sample of white-ash bent work, broken to show interweaving of wood fibers, the result of wood bending by end pressure, W. G. Shepard & Co., New Haven.

Trucks and skids.

Store and railroad trucks, in rock elm and hickory grown in Michigan. Presented by the United States Truck Company, of Detroit, Mich. First-growth woods only are used.

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D.—HARNESS WOOD-WORK.

Saddle-trees.

A number of samples were received from Miller & Buchanan, Front street, Cincinnati, Ohio.

These are manufactured from oak, elm, hickory, ash, or whitewood; sometimes beech and sweet gum, though poplar is the most common. The saddle-tree business has declined somewhat in recent years, partly owing to the fact that there are fewer saddle-trees in use, but nevertheless, it is estimated that the twelve principal factories reported give employment to some four hundred persons, and represent an invested capital of a quarter of a million dollars.

Machines used in this industry are chiefly crosscut, rip, and band saws, tenoning and boring machines. After the wood work is made, the trees are covered with rawhide, or with mosquito netting pasted on, and these are strapped with iron; the trees that are hide-covered are usually nailed together, but the other kinds are joined with glue, and if the lumber is not seasoned is thoroughly kiln-dried. The labor is about two-thirds of the total cost. The lumber supply comes from Indiana, Ohio, and West Virginia. A manufacturer in Central Ohio, who uses oak and elm, says large brash trees of old-growth oak furnish excellent timber for the purpose, the heart of the tree being excluded. Elm is also used, and sometimes preferred, because it is less liable to split. When poplar is used it must be clear and soft and first class.

Hames.

Patent "Mine and lumber hame" from white oak, presented by Thomas Beagle & Son, Philadelphia.

Hames are made from white ash, oak, maple, hickory, and rock elm. Wood must be of best quality, clear and tough, and should be cut in the winter season. All parts of the lower portion of tree used. The lumber goes through fifteen different hands or processes before reaching the finished hame, though a manufacturer of steam-bent hames says: "These are handled twenty-five to thirty times from the slitting-saws to the packing boxes."

Stirrups.

Block stirrups of horse-chestnut. Donated by O. V. Flora, Madison, Ind.

White ash, black ash, hackberry, and other woods are also used. The stirrups are steam-bent, requiring a half a dozen different operations in manufacture, labor representing about one-half cost of goods when ready for market. Suitable timber for this purpose is said to be scarce. They are sold principally South and West.

Whip-stocks.

Whip-stock in holly and Osage orange. Presented by Messrs. Schneider and Pachtman, of Philadelphia, Pa.

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III.—IMPLEMENTS OF INDUSTRY.

Into this division are grouped such machines or tools, wholly or in part of wood, as are used by man in purely industrial pursuits or in economizing human labor. For convenience the synopsis is arranged by occupations as follows:

A.—MINING AND EXCAVATING: Winch or windlass of hickory and oak, or other firm woods; ladders, oak and spruce, usually; pick, shovel, and other handles in hickory and white ash. (See also Shaft-sinking, Architecture, and Building.)

B.—FARMING AND DAIRYING: Windmills, pine, Norway pine; agricultural implements, in part of oak, ash, maple, hickory, whitewood, and pine; bee-hives and frames, pine, bass-wood, and poplar; churns and butter-workers, pine, spruce, maple, bass-wood, poplar; dairying implements in various woods.

C.—SURVEYING: Parts of tripods, rods, &c., maple, cherry, white birch, &c.

D.—WOOD-WORKING: Carpenters', cabinet-makers', and house-builders' tools or parts of tools, in various woods, as shown below.

E.—PRINTING AND ENGRAVING: Cases, cherry and whitewood; "furniture" and reglet, cherry; type, border, and rule, rock maple, cherry, and pine; engraver's woods.

F.—SPINNING AND WEAVING: Parts of looms, shuttles, persimmon, &c.; spools and bobbins, maple, white birch, apple, &c.

G.—Miscellaneous.

A.—MINING AND EXCAVATING.

This group was not represented except in pick and shovel handles, which, for convenience, are placed with "Articles relating to trade; C.—Turned articles."

B.—FARMING AND DAIRYING.

Agricultural implements (parts).

Scythe-snaths, plow-handles, and cradle-fingers, in hickory and white oak. Contributed by Pelton & Abell, Lowville, N. Y.

In manufacturing scythe-snaths only young growth wood is used, and as all knotty wood and all heart wood is rejected only a small portion of the tree is used. The material for the snath is split out of the right size to round up 2½ inches at one end and 1½ at the other, and 5½ feet long; they are then put in shape for the drawing-knife by having the surplus wood taken off with a band-saw, then shaved by hand round and as near a true taper as can be made by hand; they are then steamed until warmed thoroughly through, and forced into a cast-iron form of the proper shape and put into a dry-kiln, where they remain until thoroughly dry; then planed by hand with a spoke-shave until perfectly round. The irons are then fitted and they are finished upon the sand belt, varnished, and packed for sale.

Black cherry is sometimes used for the purpose. There are said to be fourteen snath and cradle manufacturers in the country, which are united in an association.

Plow-handles are usually made from first quality, clear, straight-

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grained white-oak lumber. After passing through several saws from the log to the handle strips, the pieces go to a concave saw, which cuts a circular strip a foot in length from one end; another machine shapes the "hand hold," after which the "strips" are placed in the dry-sheds to season (from four to six months). Then they are steamed, bent, and upper edge rounded by machinery, polished, and finished.

The wood that enters into farm implements comprises but four kinds chiefly: hickory, oak, white ash, and poplar. Rock elm, bass-wood, and hard maple are used to some extent, particularly in the West, while pine is sometimes employed for special parts. A large establishment in Michigan, which manufactures plow-cultivators, harrows, and a line of similar implements, gives the following as the proportions of the different kinds used: White oak 50 per cent.; rock elm three fourths of the remainder, and hard maple about 12 per cent. The proportion of material to labor in this class of manufactures is about one-eighth to seven-eighths. An Ohio concern manufacturing twenty thousand implements annually, and consuming several millions of feet of lumber, uses over 50 per cent. of white ash (Ohio), nearly 35 per cent. of poplar or whitewood (Kentucky and Tennessee), the remainder, a little over 5 per cent. each, white oak and hickory from Ohio.

This lumber is first and second growth, cut at all seasons of the year, and all parts of the wood used that are sound and good. The woods average in price $20 to $25 per thousand feet in plank. The waste is about 10 per cent.

It is not generally known that the lumber from which plow-beams are made is air-seasoned from one to two years after being rough sawn into the shape of beams, a shed being used for the purpose. When finally finished they are given a heavy coat of linseed oil, and lastly varnished.

The J. I. Case Manufacturing Company, which uses about four million feet of lumber annually in the manufacture of its threshers, horse-powers, and saw-mills, draws its supplies from the following sources: Pine and bass-wood, Wisconsin; ash, elm, and maple, Michigan; oak, (and some ash), Indiana; poplar, Kentucky and Tennessee.

This company reports some nineteen factories engaged upon this special line of agricultural implements, with an estimated capital of $15,000,000.

Windmills.

Parts of windmills, in white ash and Michigan white pine. Donated by B. S. Williams & Co., Kalamazoo, Mich.

There is no special process or machinery employed in manufacturing wind-engines, ordinary wood-working machinery being used. The ash rims or felloes to the wind wheels are steamed and bent, then dried and cut to shape, and afterward soaked in hot linseed oil, to make them more durable. Norway pine is sometimes used.

Pumps.

Most common wood used is yellow poplar, oak being employed for

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handles. The necessary machines are swing-saws, ripping-saws, tenon-machines, machines for making smooth valve seats; augers for boring tubing and spout-holes; lathe; machine for dressing buckets; reamers, slotters for setting brackets. The lumber passes through about eighteen processes (or rather hands) before it is worked into a complete pump, ready for shipping. It is usual to thoroughly steam all material after it is bored and machine work is done on it. This removes the sap, as it dries out rapidly and prevents bad effects on water. The labor, including clerks, foremen, &c., represents about one-third of cost of product.

A pump-manufacturing firm at Greencastle, Ind., makes the following interesting statement:

The very best quality of clear poplar lumber is required for pump manufacture. The timber employed is among the most valuable varieties grown in our country, and while it is better adapted to the making of pumps than any other timber we know of, it is also so well adapted to nearly all purposes for which timber is used that the demand on it has been so great that it has become nearly exhausted in every section of the United States where it was found in greatest abundance. The main supply that is left will be found in a few of the Southern States, and within one or two decades it will be exhausted there. Our supply here is practically exhausted, and we expect from this time forward to get most of the supply from the South.

An association of pump-makers was formed in 1880, including 90 to 100 factories, with estimated capital of $1,000,000, and employing some 1,200 hands.

In connection with pumps, I may mention an industry peculiar to the oil regions of West Virginia, the manufacture of "sucker-rods" from ash and hickory, used as connecting-rods for pumping oil-wells. The logs are cut 28 feet long, and must be clean, sound, and A No. 1 in every respect. They are sawed into strips $1\frac{1}{16}$ inches square at one operation, on an automatic mill (two saws, one running perpendicularly, the other horizontally). They are then run through a four-sided molder or planer, made $1\frac{9}{16}$ octagon, and then are ready for market. No heart-wood can be used.

The superintendent of the Rowlesburg Wood Works, Rowlesburg, West Va., says:

For the past twenty years the Pennsylvania oil regions have drawn on Ohio for supply of above goods. Timber about used up. I have experimented with yellow pine, and find it adapted and eventually it will, I think, be used.

Bee-hives, and parts.

Bee-hive of Michigan white pine; brood and wide frames of pine, bass-wood, and whitewood. Donated by A. I. Root, Medina, Ohio.

Mr. Root states that nearly every grade of Michigan pine and usual log run of bass-wood, winter cut, is used. Bass-wood and poplar come from Ohio. Prices average $10 to $40 per M for pine, and $10 to $20 for other woods; there has been an increase of 25 per cent. in cost of bass-wood in ten years. Notwithstanding the increase in cost of bass-wood, Mr. Root is of the opinion that the supply will be equal to the demand for a long time to come, as it grows rapidly and, compared with other kinds of lumber, is but little used by manufacturers; in fact, he

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says, there appears to be more offered now, and of better quality than ten years ago.

There are about fifteen manufactories in the United States; capital and hands employed not estimated.

Churns and butter-workers.

These are of infinite variety, employing many forms, including some that would classify the manufacture with cooperage. Yellow poplar, pine, maple, bass-wood, and black birch are the woods commonly used, poplar and pine being employed for receptacle and the other woods for frames and parts.

Rake, fork, hoe, and other handles. (See Articles relating to trade; C.—Turned goods.)

Usually turned, one machine only being used; after wood is brought into rough state, care must be used after turning to keep the handles in a dry, dark place.

Ox-bows.

"In the manufacture of ox-bows, sap-wood of hickory, with the inner bark on each piece, is only used."

C.—Surveying.

Tripods.

Compass-tripod in cherry; extension tripod in yellow birch. Presented by W. & L. E. Gurley, 514 Fulton street, New York.

Rods.

One New York rod in hard maple; one Troy rod in cherry; architect's rod in maple, W. & L. E. Gurley, as above.

This firm also manufactures drawing instruments, T-squares, flag-staffs or ranging-poles, drawing-boards, packing-boxes, &c., using the best straight-grained lumber in cherry, maple, beech, pine, and spruce. Considerable mahogany is also used for instrument-cases. The plant of an establishment of this kind includes power planing-machines, jointing-machines, circular saws, with all the modern attachments, shaping-machines with dovetailing attachment, gig-saws with adjustable tables, gauge-lathes for turning tripod-legs, and sandpapering-machines.

Cheaper forms of tripods are sometimes made of white ash, and instrument-cases of cherry.

D.—Wood-working tools.

Plane-blocks.

One set of seven bench-planes in beech and apple, illustrating different stages of manufacture. H. Chapin's Sons, Pine Meadow, Conn.

One set from John Cotton, 247 South Second street, Philadelphia.

One set from Auburn Tool Company, Auburn, N. Y.

Large collection of bench and other forms of planes in series, from Sandusky (Ohio) Tool Company.

The woods employed in this series are white beech, apple, hard maple, oak, hickory, and foreign woods, such as rosewood, ebony, lignum-vitæ, &c. In addition to planes, the Sandusky Tool Company manufactures

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all descriptions of cabinet-makers' implements, planters' hoes, awls, and other small tools, ice-tools, bench-screws, hoe, hatchet, hammer, and saw handles, and coopering instruments. From two to three hundred car-loads of white-beech timber are required for planes, which is cut in the northwest counties of Ohio and Michigan.

The ash for 10,000 dozen of hoe-handles is annually secured from the adjacent counties, while 40 to 50 car-loads of sugar-maple are annually made up into bench-screws and similar wooden instruments. Twenty to thirty car-loads of hickory are used in the construction of handles for small tools, while of apple, boxwood, rosewood, ebony, and lignum-vitæ from 50 to 60 tons are constantly kept on hand for the manufacture of croquet-balls, fancy planes, panel floors, &c. A stock of beech and maple is kept for two years ahead, which by additional dry-kiln facilities is most thoroughly seasoned before being used, for if the slightest bit of heart-wood appears in the cut the plane is marked a second. The sap or white part of thrifty second-growth trees is chiefly used.

Wood screws.

Series of wood screws, clamps, &c., from Milton Aldrich, Lowell, Mich. Screws of white hickory; frames, beech, white birch, and hard maple. Also set of screws from Auburn Tool Company.

A good quality of hickory is required, but not confined to second growth. Mr. Aldrich writes that the hickory used in his establishment comes from Maine, New Hampshire, Massachusetts, Ohio, and North Carolina, and costs from $50 to $150 per thousand. The beech, birch, and maple are received from home sources. In making wooden screws the log is first cut to proper lengths, split through the center, and the pieces sawed out as desired. These are stored for a season, then taken and treated with steam and dried, it being desirable to dry as far as possible by natural heat. When dry they are returned to the factory and worked into the different parts which go to make up the wooden screws. Woods pass through planing-machines, lathes, cutting-machines, a boring-machine, sandpapering, beading, and grinding machines, screw tools, &c.

The wastage is 30 per cent. for the logs or planks, with a subsequent loss of 10 per cent. for dimensions.

Spirit-levels.

In cherry, from H. Chapin's Sons, Pine Meadow, Conn.

Spirit or mechanics' levels are usually made of mahogany or rosewood, or some of the denser foreign woods. When native woods are employed, however, black cherry is preferred, of the best quality, heart-wood only of old growth being used. Messrs. Stratton Brothers, of Greenfield, Mass., state that only about 20 per cent. of native lumber is used in this industry.

Gauges.

A series in maple was contributed by H. Chapin's Sons, Pine Meadow, Conn.

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Rules.

Bass-wood foot-rules for advertising purposes, Milton Bradley & Co., Springfield, Mass.

Apple-wood rules from H. Chapin's Sons, as above.

These advertising or penny rules are made in two styles, the international with metric system, and the ordinary mechanics' rule in inches and subdivisions from fifths to sixty-fourths. The advertisement is printed upon the back.

Mallets.

Series of hickory mallets, from the Sandusky Tool Company.

Saw-handles.

A large series of saw-handles was donated from H. Disston & Sons, Philadelphia. Outside wood only is used, the kinds being apple, beech, cherry, and black walnut.

Other handles. (See Articles relating to Trade; C.—Turned articles.)

E.—PRINTING AND ENGRAVING.

Wood type.

One large series of wood type letters, borders, &c., in hard maple, handsomely mounted. William H. Page Wood Type Company, Norwich, Conn.

Wood type in hard maple, from Hamilton & Katz, Two Rivers, Wis.

Mr. George C. Litchell, president of the William H. Page Wood Type Company, in reply to the request for information, makes the following interesting statements:

We manufacture wood type, borders, quoins, printer's furniture, engraver's woods, job sticks, and wood rules, using rock maple for wood type and borders, boxwood and hickory for quoins, cherry and pine for furniture, boxwood, mahogany, pine, and rock maple for engraver's woods, mahogany for job sticks, rock maple for wood rules. Rock maple and hickory are received from Connecticut, the boxwood from Turkey, and the cherry from Pennsylvania; our pine comes from Michigan, and mahogany from Cuba.

The rock maple and white pine for general uses are first growth, and the best wood that can be obtained. It may be explained that wood type, borders, and wood rules are used for "show-bill" printing; boxwood, mahogany, pine, and rock maple for engraving purposes; quoins for locking up forms on printing presses; furniture for spacing between lines of forms; job sticks for setting up lines of type.

The hardest of second-growth rock maple is used exclusively for wood type, and is all used alike without regard to sap, as there appears in maple no sap or part different from main body of the wood. The heart or center of log is not used. We prepare the wood by cutting it up across the grain in $1\frac{1}{8}$ thickness. The best maple is native of Eastern Connecticut. We have tried maple from other parts of the country, but none so good as our pasture-grown maple, the logs being split through in the middle at a saw-mill and delivered in half logs. Waste in manufacture, 25 per cent.

Wood for type is sawed up in the green state and first boiled in water, then dried about two years; then subjected to fire heat for six weeks or so; then dressed out type high and finished on the one side for face, and sawed into strips of lines pica to suit the size of type to be made, and then letters are cut by machinery, and the last process is to look them over and hand-finish what the machine does not do; then they are oiled with linseed oil and packed and shipped. Labor represents 80 per cent. of cost.

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Engraver's woods.

The most common wood in use is Turkey boxwood, mahogany being also employed to some extent. Samples of engraver's blocks in hard maple were donated by Vandeburgh, Wells & Co., New York City. Samples were also received in pine and "American boxwood," Longacre & Co., Philadelphia, Pa.

(Inquiries were made of Messrs. Longacre & Co. for definite information concerning this wood, but no replies could be obtained.)

Reglet, furniture, &c.

Series of cherry reglet, &c., from Vandeburgh, Wells & Co., Fulton street, New York. The firm also contributed series of type cases.

F.—Spinning and weaving.

Shuttles

Shuttles in apple, dogwood and persimmon, with wood in rough. Presented by the North Carolina Shuttle Works, Bush Hill, N. C.

Bobbins.

Collection of bobbins in hard maple from Michael Quinn, 332 Master street, Philadelphia, Penn.

Spools.

A collection of spools from L. H. Dwelley, Foxcroft, Me.; birch. (See also Articles used in trade; C.—Turned articles.)

The following interesting letter is received from Mr. Dwelley:

In compliance with your request of the 2d intant I herewith make a few statements regarding spool manufacture, the spools being used principally for sewing silk, linen and cotton thread. I also manufacture turned wooden boxes, and various other articles in which only second-growth white-birch wood is used, as from its special character it can be worked with greater economy than any other wood known to the writer.

White birch is found in great quantities in Piscataquis County, Maine, my supply being obtained within a radius of 20 miles. It is found growing from size of the smallest sapling to 20 (sometimes more) inches in diameter at a few feet from the ground. It is a common practice to leave all the trees standing that are less than 6 inches in diameter, thus cutting only the larger growth and allowing the smaller trees to grow to suitable size before being cut.

I am using annually about 2,500 cords of this wood, making, when sawed into squares of suitable sizes to make the various sizes of spools, &c., from 1,000,000 to 1,200,000 feet (board measure) of spool stock. These square sticks, which are usually cut in 4-foot lengths, are first thoroughly seasoned in the open air, after which the timber may be kept for any length of time, if not exposed to moisture. White birch, however, must not be allowed to remain in logs with the bark on in hot weather, unless kept in the water, as it will commence to decay in an exceedingly short time, rendering it unfit for use; consequently I have all my spool timber prepared during the cold weather, of which there is no lack in this latitude. After the stock is sawed in the 4-foot lengths and properly seasoned, the pieces are cut into short blocks and then are dried in a hot-air kiln. When again sawed a hole is bored through them. One whirl of the block against a set of sharp knives, shaped by a pattern, makes the spool, at the rate of one a second. The spool-machine is fed by a boy, who places the blocks in a spout, throwing out all that are knotty or defective. In polishing, the spools are simply revolved rapidly in drums and finish themselves.

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G.—MISCELLANEOUS.

Shoe-lasts and boot-trees.

One set of shoe-lasts in second-growth sugar-maple, contributed by Messrs. Wing & Smith, Burlington, Vt.

Another set in sugar-maple, persimmon, and apple wood, from Crawford, Coffman & Co., Dayton, Ohio. This firm also donated crimping-boards in maple.

Messrs. Wing & Smith state that lasts are manufactured from both dry and green maple; the dry is air-seasoned, the green by steam heat, the blocks dried by air requiring a year or more time, the green blocks ten to fifteen days.

They use the Gilman & Townsend last-grading lathes, manufactured at Springfield, Vt., for lasts; for boot-trees, those of their own construction.

The process of manufacture is as follows: Logs are sawed in lengths required for lasts of the sizes we are turning; split and hewn to proper size, then turned, after which they are put in a steam dry-house, where they remain from ten to fifteen days; then put on racks, where they remain until wanted to finish. The finishing is: First, sawing the blocks; second, cutting heels and toes; third, shaving same; fourth, scouring on wheels; fifth, polishing; sixth, strapping and tying up; seventh, boxing.

Blocks dried by the elements are not white, as the process of drying is slow, but in the case of steam-drying they are as white as the wood in its natural state; further, steam-dried lasts are susceptible of a very high polish.

This firm uses but little persimmon wood, owing to its expensiveness. Very few boot and shoe makers are willing to pay the difference in price, the cost of the lasts in the rough (turned lasts) being about 30 cents per pair; when finished maple lasts can be sold for 20 cents. Birch lumber, such as used for crimps, costs about $30 per 1,000 feet. All turned lasts require models for the lathes, and the same must be made by hand. Good last-model makers require many years' experience. The eye has much to do in making a good model, as well as taste. Fashions change so often a model-maker must be able to make any style required, and he must also be a person of quick perception and possess an artistic eye. Special lasts for deformed feet are often required.

Messrs. Crawford, Coffman & Co. state that they use the lower and clean part of rock-maple trees, principally, cut at all seasons, though they think the lumber is best cut between June and November. The sap-wood forms the main body of the last, leaving only a small amount of heart, usually none, on the top of the last. It is further stated that the seasoning process is a difficult and delicate one, owing to the liability of checking, or injuring the fiber of the wood. If dried too slowly it takes a stain; or if dried too rapidly, the wood becomes porous and

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brittle. The last, from the log of wood to a finished article, passes through or over about seven machines and fourteen distinct operations, labor being about 50 per cent. of the cost.

There are said to be some seventy or more last-making establishments in the United States, with an invested capital of $1,000,000.

Shoe-pegs.

Shoe-pegs are made from white and silver birch and white maple, only the best-selected bodies of trees being used. The wood is cut and hauled as wanted, the sap-wood being used, and the heart or red part removed and thrown away.

A New Hampshire shoe-peg manufacturing firm that produces 40,000 bushels annually uses second-growth birch, which is considered a quick-growing timber; and it has been found that the supply equals the demand in the particular section where the mill is located. The wood is worked green and seasoned in the process of manufacture. A shoe-peg goes through eighteen different hands or processes, and 75 per cent. of cost is labor.

There are not over ten shoe-peg factories in the land, employing perhaps 200 hands, and with a capital of $125,000 to $150,000. Large quantities of shoe-pegs are exported.

Hat-blocks, wig-blocks, &c.

Collection of wig-blocks in gum; hat-block and hat-flanges in poplar, curling-board in poplar; hat-stretchers (wood unknown), manufactured by Christian Nonnenberger, 323 Race street, Philadelphia, Pa.

Mr. Nonnenberger makes the following interesting statement regarding hat-blocks:

For our work the wood must be perfect, as cracked lumber we cannot use. Indiana poplar is preferred, though it is getting very scarce, so that we are obliged to buy it three and four years in advance in order to have it properly seasoned. The wood is placed in a room with coal fire burning night and day to dry it. The different machines through which a hat-block passes: band-saw; circular saw; gig-saw; planing-machine; turning-machine; oval-machine; curving-machine, then finished by hand, passing through four hands. Other manufactures are: flanges used for shaping the brim of felt hats; curling-boards for shaping brim of silk hats; stretchers for enlarging hats; hat-sets, used, one to lengthen and one to widen a hat, according to shape of wearer's head.

IV.—USES OF WOODS IN ARTICLES RELATING TO TRADE.

Into this division are grouped a large class of articles used in trade, the majority of which find employment only as packages or receptacles for merchandise, and many of which are used but once, and then thrown away or destroyed. In some instances, however, as with certain kinds of cooperage, basket work, or measures, their use in store or warehouse may be more or less continuous. Among exceptions should be noted hard-wood veneers, which, on some accounts, might be more readily classed with furniture but for the fact that veneers or thin-cut woods

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are used at the present time in so many different forms directly relating to trade. The group of wood industries is arranged as follows:

A.—COOPERAGE (shooks, staves, heads, and hoops): Tanks and vats, cedar, spruce, white and yellow pine, cypress; sugar-hogsheads, oak, maple, beech, and birch; flour, fruit, and provision barrels, red oak, ash, bass-wood, white oak, red, white, and rock elm, beech; heads, bass-wood, white and red oak, ash, maple, birch, butternut, hickory, and poplar; fish and lard, second-growth white pine, &c.; molasses, sugar, and liquor, white and red oak, elm chiefly; sirup, bass-wood, pine, oak, and other hard woods; nail-casks, spruce with pine heads; butter tubs and firkins, oak, spruce, hemlock, ash; fish kegs, maple, pine, ash, &c.; spice-kegs, chestnut; oyster-tubs, spruce and oak; paint and lead tubs, kegs, and pails, white and red oak; pails, tubs, &c., for domestic use, oak, ash, cedar, cypress, pine, and spruce.

B.—SPLIT AND SHAVED WOODS: Wood measures, sieve-rims, &c., oak, beech, and maple commonly, sometimes bass, poplar, cherry, and white birch; cheese-boxes, oak and elm, white elm, bass-wood, and poplar headings; basket work, oak, ash, pine, &c.; barrel-hoops, oak, ash, elm, hickory, and various hard woods; fish-fykes, hickory and oak.

C.—TURNED ARTICLES: Handles in various woods, wooden pill and chemical package boxes, white birch; match-boxes, pine, poplar, &c.; package cases, white birch; bungs and plugs, poplar, pine, &c.; button-molds, maple and birch; faucets, beech, birch, and maple; dowells, maple, white and yellow birch, beech, &c.; sugar and other scoops, maple and willow; map, chart, and other rollers with knobs, bass-wood, ash, cherry, and maple; spool and braid rolls, ribbon-blocks, &c., white birch.

D.—VENEERS: Furniture veneers in all hard woods; "perforated" veneer work for chair-bottoms and similar uses, ash, maple, oak, walnut, &c.; lard, butter, and pie plates and trays, sweet-gum, beech, birch, and maple; match-boxes (square), pine, beech, and birch; wall hangings, all hard woods; excelsior, bass-wood, birch, poplar, cottonwood, and buckeye; paper-backed inlaid veeners, for decorative purposes, all fancy woods; sorrento carved panels, all fancy woods; business cards, cross-section, hard woods.

A.—COOPERAGE.

Kegs.

One one-fourth anchovy keg in maple wood, with willow hoops; one one-half gallon oyster-keg, ash throughout; one Russian sardine-keg, maple wood, with maple hoops; one spice-keg (small size), chestnut throughout; from William S. Robinson, New Haven, Conn.

Series of white-oak kegs, lead and paint buckets, &c., from Hill & Wright, East Boston, Mass.

Tubs and pails.

Oyster-tubs (sometimes called pails), in spruce and in white oak, with pine covers; also, butter-tubs, in white ash, with black-ash hoops; William S. Robinson & Co., New Haven, Conn.

One spruce tub, use not specified, from Frank E. Vaughn, Elizabeth City, N. C.

Spruce butter-tubs, Flanders and Son, Parishville, N. Y.

Butter-tubs, in white ash and white oak, with hickory hoops; presented by D. C. Mason, Fulton street, N. Y.

While the processes for manufacturing all kinds of cooperage are in the main similar, a few descriptive notes will not be out of place. Mr. W. S. Robinson, of New Haven, illustrates the subject by giving the different steps in the manufacture of an oyster-tub or shipping-pail as follows:

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In making oyster-tubs I use nine machines besides the large tub-lathe, which is a combination machine. Three and four inch plank is first cut right length for staves on circular saw; then sawed in right shape on barrel-saw, kiln-dried; then both ends sawed off at once, making it exactly right length; then sawed lengthwise, both sides (jointed we call it) to the right shape; then matched to each other with tongue and groove, like flooring; then set up in ring and put on to the lathe one side and turned smoothe on the outside, and on the other turned smooth on the inside, and groove cut for bottom. Bottom and cover turned on another machine. Hoops are cut off and two holes punched for rivets by one machine, flared by another, and bent by another. We have a press for making most of the iron trimmings, but handles, part of bail-ears, and staples we buy. Proportion of labor to cost is one-half or a little less to nearly two-thirds on some sizes. The labor is a larger proportion of cost on small packages than large ones.

Butter and lard tubs are made from white and black ash timber, bass-wood, spruce, hemlock, oak, pine, elm, maple, &c., old trees being preferred. Sometimes made of sycamore, though not to any extent, owing to comparative scarcity.

Casks and barrels.

Barrels in southern pine; Philip Hirsch, New Orleans.

Oak and whitewood barrels, staves, heads, &c.; Grand Rapids Stave Company, Grand Rapids, Mich.

White-oak casks and yellow-pine barrels; from A. F. Page & Sons, Blue Crossing, N. C.

Barrels, barrel-hoops, head-linings, &c.; Burrel & Whitman, Detroit, Mich.

Casks in white oak, for beer, ale, and liquors; Hill & Wright, Boston, Mass.

In making a liquor or other cask, the material is prepared in the same manner as described above (see Oyster-tubs). Staves are dressed, jointed, raised in truss-hoops, heated or steamed, ends pared and finished, heads made and put in, and after hooping it is subjected to heavy air pressure from a pump to ascertain if it is perfectly tight. A Southern manufacturer says that sap-wood should not be used for liquor staves, though it may be used for pork, lard, pickle, oil, sirup, and other casks. Flour-barrel staves, for the Minneapolis trade, are made principally from red oak, elm, ash, and bass-wood; barrel-headings from bass-wood. The following interesting description is given of the necessary steps in the manufacture of so simple an article as the head of a flour-barrel:

The wood comes to the mill either in logs or bolts, the latter being blocks of timber split out of the log to the required length. Bolts cut from basswood logs 38 inches in length, peeled and delivered to mill, where they are cut in two, with cut-off saw, then cut into cants five-eighths of an inch thick with heading-saw, dropped on chain carrier and conveyed to cars in front of dry-kilns, on which they are piled; then passed through dry-kilns, requiring from forty-eight to sixty hours to dry same; still on cars the bolts pass down track to planer in heading-mill; the pieces are then planed and brought to one-half inch thickness; then jointed and pass to watchers, who place sufficient number of pieces together to make a head; each set of pieces is then placed in heading-turner, clamped, and circled to proper size. As it falls from clamps the pieces composing each head are picked up by a boy and placed in a holder, and from there they go to the packer, where they are done up in bunches containing 12½ sets to the bunch; iron straps sometimes used, and sometimes tarred string.

Tanks.

One spruce tank, wood from Michigan (made also of cedar, cypress, and hard pine); William L. Philbrook, Boston, Mass.

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Cooperage for household use.

Flour buckets in white pine; United States Truck Company, Detroit, Mich.

White and red cedar pails and tubs and white cedar dash-churns; from New York Cedarware Company, New York City.

Red and white cedar tubs; Clement & Dunbar, Philadelphia, Pa.

Wash-tubs in white pine, water-pails, flour-buckets, &c., white pine, barrel covers, &c.; Wilder P. Clark, Winchendon, Mass.

Ice-cream freezer, pine; from the White Mountain Freezer Company, Nashua, N. H.

Shooks.

Sugar-hogshead shooks, made principally from oak, maple, birch, and beech. The hogsheads are made and put together, then knocked down, and the parts packed in bundles ready for shipment to sugar-producing countries. A large Eastern manufacturer writes:

When I went to my trade, forty-five years ago, we used to get quite a supply of stock from Maine and New Hampshire, particularly of red oak for sugar and molasses shooks. That supply has failed us for twenty years or more, and the shook trade for Cuba has gone from Maine and across to the West. Hundreds of men were formerly employed in those two States, and now there are none. Lumber for a shook costs about 50 cents; labor about 27 cents. The shook passes through four different machines and five hands from log to finished article.

Following list of woods used for cooperage, with principal articles of manufacture:

White pine.—Pails, tubs, keelers, churns; fish, lard, and sirup packages (kits, kegs, and barrels), tanks.

Yellow pine.—Tanks and vats.

Spruce.—Nail kegs and casks, lime and cement barrels, butter and sugar tubs, oyster-tubs, &c.

Poplar.—Churns.

Cottonwood.—Flour and sugar barrels, and barrel-heading.

Cypress.—Tanks, tubs, and vats.

Red cedar.—Pails and tubs, chiefly for domestic use.

White cedar or juniper.—General "cedarware," as tubs, pails, measures, butter-churns, tanks, vats, and reservoirs.

White ash.—Oyster-kegs, butter tubs and pails, flour and fruit barrels, hoops.

Black ash.—Butter and lard packages, hoops.

Basswood.—Sirup-packages, flour-barrels, but mainly flour-barrel headings.

Birch, (variety not stated).—Sugar-hogsheads, flour-barrels.

Beech.—Sugar-hogsheads, lard-packages, butter pails and tubs.

Chestnut.—Butter-pails, spice and other small kegs, headings small kegs.

Wild cherry.—Butter-tubs.

Elm.—Flour and sugar barrels, butter-tubs.

Maple. — Flour-barrels, lard-tubs, sap-buckets, butter-pails, sugar-hogsheads shooks), fish and other small kegs, keg-hoops.

Butternut.—Flour-barrels.

Sycamore.—Butter-tubs and barrel-headings.

White oak.—Shooks for molasses and sugar hogsheads and barrels, butter-tubs, beer and all barrels, kegs and pails for white lead, paints, &c., oyster-tubs, well-buckets, liquor and other casks, tanks, and barrel-headings.

Red oak.—Flour-barrels, chiefly.

Hickory.—Flour-barrel headings and hoop-poles.

The quality of lumber varies with the use, "first quality" being usually reported, though in some cases manufacturers are careful to state "best quality of second growth," the trees felled in the winter

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months. Little or no difference is made in the portions of tree used, as heart or sap, so the wood is sound. In some New England manufactories where a cheaper grade of pine cooperage is made "sapling pine" of home growth, good, bad, and indifferent, is used. The sapling pine is drawn to the mill-yard cut in lengths of about twelve feet. Large logs are split with upright mill-saws; others cut in length by circular saws leaving the joints or knots (which are usually in circles about the log) as waste wood. These blocks are from fifteen inches to six inches in length. After sawing into staves they are piled in the mill-yard, and when dried are packed in sheds until wanted for use, and put in dry-house. Bottoms for pails and tubs are cut from such lumber as seems best adapted for the purpose, when sawing is being done, usually from the largest logs.

A manufacturer in Winchendon, Mass., who was asked his opinion regarding the supply of white pine in his State for cooperage purposes, says:

White pine is of rapid growth. There are large amounts grown and cut in this section, and from some standpoints it may seem that waste and destruction are going on at a fearful rate, yet from the best information that I am able to obtain I judge that in this town and vicinity there are as many cords of sapling pine suitable for use as there have been at any one time for the past forty years; of course old-growth pine is very scarce; in fact, all timber of old growth is becoming very scarce.

B.—Split and shaved woods.

Measures and round nest-boxes.

Dry measures, one complete set; nest-boxes, several sets, presented by Gage & Co., Henniker, N. H. These are: rims, white oak; bottoms, white pine.

Series of fruit, salt, and axle-grease boxes, in pine and hard woods, from Thomas Annett, East Jaffrey, N. H.

These boxes and measures are made from a variety of hard woods that may be cut into thin, broad strips and bent in circular form. Beech, birch, white ash, elm, hard maple, and white oak are used for hard-wood portions, the bottoms and covers being made of sapling pine of native growth. The pine log is sawed into boards one-fourth of an inch thick, kiln-dried, planed, and then cut into circular pieces from six to ten inches in diameter, for tops and bottoms of the different boxes. The hard-wood log is sawed into blocks, then steamed and sliced into thin strips for the body of the box. These strips are bent into circular form, the ends tacked together, and the circular heads driven into the bottoms and fastened by wooden pegs. Covers are made from narrow strips in a similar way. The boxes are next sand-papered, which is the finishing process, except for the best qualities, which are varnished. The finished box has passed through twelve different machines. Proportion of total cost representing labor, 60 per cent.

Bent wood is also manufactured into churns, white ash being employed. Other manufactures are drum-hoops, banjo, tambourine, and

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basket hoops, sieve hoops, coal-hoops, riddle-hoops, children's rolling-hoops, and cheese-boxes. An Eastern manufacturer states that drum shells, formerly made from wood entirely, are now made mostly of metal tin, brass, and German silver being used. In the manufacture of children's rolling-hoops, beech, maple, and oak are largely used, lumber and labor each amounting to one-third of cost, the remaining third being represented by cartage and freight and profit. The following stages are given in the manufacture of a child's hoop: (1) Log sawed; (2) plank sawed; (3) strip planed; (4) strip tapered on saw; (5) strip split (making two hoops); (6) edges planed; (7) steamed; (8) bent, 12 sizes; (9) tacked; (10) laps smoothed on sand-wheel; (11) sandpapered; (12) nested or packed in one-half gross bunches, the sticks for driving them being boxed in one-half gross package and secured to inside of circles. A rim and hoop manufacturer of West Chesterfield, Mass., makes the following reply as to parts of tree used:

Of maple we use old growth for thin and wide hoops, where it works well. For banjo and other thick hoops, snare-drum rims, &c., we have to use second-growth maple exclusively, on account of toughness and superior bending qualities. Sometimes soft or white maple is used in place of second-growth rock maple, but only in case of very nice log.

All heart lumber contains more or less knots, and is of little use for hoops of any kind, and we use it for turned goods (hammer-handles, drum-sticks, and toy ball-bats).

Baskets in split wood.

Mill baskets in white ash. Donated by E. H. Goodrich, Hinsdale, Mass.

These are also made from bass-wood of first quality, cut at any season. In preparing the wood for basket-making the log is split as near the eye as possible, shaved to the proper thickness, pounded with a heavy hammer on an anvil; the stick is then held in such a position across the anvil that by pounding it the grains are loosened, so that they can be pulled apart; these strips are then smoothed and braided on blocks, which, after being dried, are tightened and are ready for the rims.

Hoops.

Hay, hogshead, and barrel hoops, from yellow ash, are made in a similar manner, the logs being quartered, split into bolts 2 by 3 inches (with the grain), then passed between two wooden rollers run by horse-power, which separate the grains, leaving the hoop when finished $\frac{3}{16}$ of an inch thick and $10\frac{1}{2}$ feet long.

C.—TURNED ARTICLES.

Handles.

Hammer, pick, and sledge handles in hickory, awl and file handles in hard maple and whitewood; W. W. Gillette, Bozrahville, Conn. (ornamental case).

Hammer, hatchet, ax, and other large handles, from white oak and hickory; Horatio Kelsey, Clinton, Conn.

Handles of tanner's and shoemaker's tools, in hard maple and cherry; William H. Horn & Bro., Philadelphia, Pa.

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Tool handles of various kinds, with illustrations of the wood in the rough, as well as turned, from B. B. Warren & Son, Plainville, Conn.

The woods represented are as follows: Butternut, cherry, white oak, chestnut, bass-wood, yellow birch, hard maple, sassafras, elm, white pine, red cedar, and beech.

Hickory chisel and other handles, from Sandusky Tool Company, Sandusky, Ohio.

Cylindrical brush-handles, in hard maple, white ash, walnut, &c. Estate of C. B. Rogers, Deep River, Conn.

In the manufacture of pick and sledge handles, the timber being received at the factory in the log, and cut usually 37 inches in length, is first sawed into quarters and afterwards sided up to the proper size for turning, sledge-handles being sometimes made from the sidings or "slabs" from the pick-handles. It then goes to the turning-machine, which brings the handle to shape, but leaves the surface quite rough. It is then placed upon a canvas belt coated with coarsely pulverized flint or quartz, which quickly removes the outer surface, but leaves the handle still much too rough for market. It then must be thoroughly seasoned if this has not already been done. Many prefer to season the timber before turning. If seasoned after turning, the handles must be looked over once or twice, and such as need it straightened. If this is neglected until the timber becomes too dry, the handles must be put for a short time into warm water, or exposed to steam. They can then readily be straightened, and after becoming again somewhat dry, the ends are smoothly sawed off and the handles again passed over a canvas belt coated with fine sand. If a fine finish is desired, they are the third time passed over the sand belt, and this time a composition of white lead, rosin, beeswax, and oil is applied to the belt, which fills the pores of the wood and adds very much to its appearance. The handles are now ready for casing and market.

Ax, pick, sledge, hammer, and hatchet handles are usually made from best forest and second-growth hickory (shellbark, black and white hickory), the best of the butts being used. These are shaped and the seasoning or drying done in darkened rooms, no steam being used, as the steaming process destroys the elasticity of the wood. The finest handles are hand shaved. Hoe, rake, D-shovel, and fork handles are made from white ash chiefly, though hard maple, beech, and even hickory are employed by some manufacturers. Shovel-handles, however, are always of white ash. A large Western manufacturer states that shovel and fork handles require timber not more than two logs from stump and only the best portions, as the soft, light timber, of which there is much in ash, is not tough enough for good handles.

Broom-handles are made of white ash and other hard woods, but usually of bass-wood as lighter and cheaper, while fully answering the purpose. One thousand feet of good lumber will make 2,000 broom-handles of No. 1 quality.

Tool-handles, such as chisel, file, awl, graver and other small handles

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are made from a great variety of woods, according to use, even fancy foreign woods, as cocobolo, rosewood, &c., being employed for fine handles. Maple and ash seem to have the preference for chisel and general small tool handles; hickory and ash are used for spinning tools; graver-handles are made from maple, apple, &c., and file-handles are considered sufficiently good when made from poplar, bass-wood, and similar softer kinds. Oak is sometimes used for small tool-handles, though not so largely as many other kinds of tougher woods. Brush-handles (paint, varnish, &c.) are also made of different varieties, according to the kind of brush. Maple, birch, white ash, hickory, black walnut, cherry, sycamore, elm, oak, red cedar, and poplar are all employed in this industry. Of foreign woods may be named satinwood, rosewood, cocobolo, olive, ebony, tulipwood, and mahogany.

Wood faucets.

Wood faucets, hard maple; E. Loud & Co., Winchendon, Mass. Wood faucets in red cedar and locust; Frances Threm, 596 Walnut street, Cincinnati, Ohio.

These are also made from beech, birch, and maple. A prominent Massachusetts manufacturer also uses about 25 tons of lignum-vitæ in his factory in a year. There are many forms of faucets, patent, metal lined, &c., but it is not necessary to mention them here.

Map-rolls.

Sets of map rolls and moldings from bass-wood and hard maple were donated by M. P. Mason, Carthage, N. Y.

Ash, cherry, and similar woods are also used. A map-roll goes through ten different processes (hands and machines) in course of manufacture. This factory turned out 800,000 sets of map-rolls—one roller, one molding, and two knobs—in a single year. The larger quantity were made of bass-wood.

Match-boxes.

Round wooden match-boxes are made from white pine and poplar, either first or second growth. Match-boxes are turned by machinery, one machine making the box and another the covers, though either machine can be gauged to make boxes or covers. Each machine is capable of making 10 gross of boxes per hour. The boxes are taken from the lathes and rattled in a revolving cylinder, which cleans and polishes them, and separates them from chips, &c.

Dowels.

Dowels are made in regular lengths of 3 feet, used for furniture, toy work, umbrella-handles, &c. Woods commonly used are hard maple, beech, white and yellow birch, and sometimes ash, elm, and other woods. In sawing lumber for dowels, about $\frac{1}{8}$ inch is allowed for shrinkage and waste. After the wood is properly seasoned, it is turned on dowel-machine, which makes from five to six thousand per day of ten hours. Dowels are not only sold throughout the United States, but are shipped to Europe and Australia.

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Spools and bobbins.

A "Whittier New Model" or Sawyer or Rabbeth spinning bobbin goes through 29 different processes from lumber to finished article, and is sold at three-fourths of a cent, or at the rate of $7.59 per thousand. The material is three-sevenths of the total cost, the balance being labor and profit. The bobbin goes through twelve machines from first to last. Sap-wood only is used.

The Willimantic Linen Company (Connecticut) give the following as the practice in the manufacture of spools in their establishment, the white part of white birch that is free from knots being used:

Trees are cut down, sawn into 4-foot lengths, drawn to the mill by horses, sawn into square bars by circular saws, timber then stacked in yard to dry; thence taken to dry-kiln, heat applied, air drawn out, passed through a condenser, which relieves it of its moisture, and then returned to the kiln by means of a blower; wood then passed through a swiftly-revolving chuck and hollow arbor, the chuck holding knives which reduces the stick to a round form; thence taken to a gang of saws which cut it into the proper lengths for spools; thence by an elevator the blocks, as they fall from the saws, are carried up one story and deposited in hoppers; from thence they are fed down a conductor to the machine which bores a hole in the center of each block, the feeding and boring being done automatically; thence conveyed to another hopper and fed down into a lathe which turns the spool, after which they are put into revolving drums and polished by friction, and when sorted are ready for market.

Miscellaneous.

An infinite variety of turned goods might be mentioned, such as chemical boxes, pill-boxes, button-molds, toys, and ornaments of every description.

D.—VENEERS.

Hard-wood veneers (for cabinet-work).

Series of hard-wood and fancy veneers, arranged in panels, presented by Palmer, Parker & Co., Boston, Mass. This series includes the following: Bird's-eye maple, white ash, corrugated cut; white ash, blister; oak branch, butternut, burl, cherry burl, California laurel burl, California redwood burl, maple blister, walnut stripe, plain walnut, curl walnut, mountain ash, curl; hard maple, plain; holly, walnut burl, and cherry blister.

From the Grand Rapids Veneer and Panel Company was received a series of veneer panels showing elm, hard maple, white ash, black ash, sycamore-black walnut, red oak, black birch, red birch, cherry, and white birch.

Veneers are of two kinds—the sawed veneers, where an entire log is reduced to thin sheets in the same manner that boards are sawed, and the rotary-cut veneer, where a knife travels around the circumference of the log, reducing the lumber to continuous sheets, which are afterwards cut into squares of any desired size. The knife-cut veneers run from the thickness of 120 to the inch to five-sixteenths of an inch. The entire log, with the exception of about 8 inches of the center or heart, is cut up.

Chair bottoms.

Perforated chair-bottoms, in three layers of veneer woods, so arranged that the grain shall run in different directions; used also for car ceilings and panels; Gardner, Holmes & Co., 183 Canal street, New York.

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Wooden butter plates.

Set of butter, picnic, and lunch plates; three-ply plaques, for decorative purposes; card-receivers, ornamental brackets, &c., from Smith & Stevens Manufacturing Company, Fulton street, New York.

The butter and other thin plates are made from sweet-gum, beech, birch, and maple, principally, obtained in North Carolina, Delaware, New York, and Vermont. The three-ply plaques, for decorating, are made from sweet-gum, white holly, maple, and walnut, obtained from the same States. Some of these are fashioned into card receivers, &c., as above.

The thin plates are made from veneers one-twentieth of an inch thick, cut into squares of the required size. When dried sufficiently they are pressed between hollow dies (eight or ten at a time) heated with live steam, the dies having circular knives fixed to cut the veneer plate or plaque; it is shaped and cut by the same movement of the lever either by hand or power. When taken from the press they are ready for use.

The three ply plate or plaque is made from the thin single-ply and glued together, crossing the grain to prevent splitting or warping; pressed between "cauls" when glued until the glue is dry, then turned in a lathe, polished and stained if desired, ready for the artist's brush or other ornamentation.

There are various forms of wood-veneer butter and lard receptacles, though all are made in the same manner. A manufacturer in Ohio makes an oval form from elm lumber; others are square, tin being used in combination to strengthen the edges, while a very common form is lapped at the ends and held secure by a couple of tacks. One firm reports 100,000,000 plates per year as the product of their mills, and there are a dozen other establishments engaged in the manufacture of one form or another of these cheap and useful articles.

Grape and fruit boxes.

The manufacture of grape and other fruit boxes and baskets is a large industry, using many hundred thousand feet of lumber. The details of manufacture are so similar, however, to the above, in preparation of the lumber, that they are omitted. Bass-wood is chiefly used, though the other woods are sometimes substituted.

Excelsior.

Excelsior from white-pine wood, in the rough and manufactured; Grand Rapids Excelsior Company, Grand Rapids, Mich.

Another collection from poplar lumber; both of prepared material, and samples of wood used; Boston Excelsior Company, Boston, Mass.

Spruce and poplar excelsior; L. Murray, Hinesbury, Vt.

There are a dozen different kinds of machines in use for reducing lumber to the form of fine shavings known as "Excelsior." After cutting the lumber to right lengths and properly seasoning it, it is run through the machine, which practically cuts it first into thin ribbons, and then in threads of fiber, by means of closely-set parallel cutters. Second-growth timber and clean body-wood is usually employed in the manufacture.

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Boxes, packing, &c.

"Lock-corner" boxes for confectionery, &c., in white pine; O. R. Wiswall, Marlborough, N. H.

Packing-boxes in cypress, from Henry Busch, 246 Commercial street, New Orleans, La.

Cigar-boxes, imitation of Spanish cedar, from white wood; Thomas Beagle & Son, 448 York avenue, Philadelphia.

Tobacco-boxes, for packing plug-tobacco, manufactured from sycamore and oak; Frost's Detroit Lumber and Woodenware Works. Sycamore tobacco-packing boxes, also; from Dusterburg, Meyer & Co., 82 East Second street, Cincinnati, Ohio.

In the New England States lock-corner boxes are commonly made of second-growth pine, and are usually ¼-inch lumber, dove-tailed by machinery, fitted together, and held by glue, the covers made to slide in grooves cut into the sides and one end. A "lock-corner" box passes through nine hands or machines from lumber to finished article, no steaming or kiln-drying being necessary, as the wood is air-dried in sheds. Cost of labor about one-half total cost. In addition to pine, as stated above, poplar, bass-wood, spruce, and fir are used for this purpose. The packing-box industry in the New England States alone is enormous.

V.—USES OF WOODS IN ARTICLES FOR MAN'S PHYSICAL COMFORT OR LUXURY.

The articles classed in this group come mainly under the head of furniture, including that manufactured for office, church, or school, as well as the household. Nearly all the best-known varieties of native woods (and a number of foreign kinds) find employment in the manufacture of these articles, by far the larger portion consumed being the higher grades of what might be termed fancy hard woods. But the softer woods, such as pine, poplar, and similar kinds, are also used largely, either in combination or alone as in cheaper makes of house furniture that receive paint as a finish.

A.—HOUSE FURNISHING AND DECORATION: Tables, chairs, etageres, hall-racks, and "parlor frames"; bedsteads, cribs, and cradles; bureaus, washstands, wardrobes, &c.; sideboards, buffets, &c.; book-cases, desks, and cabinets; bric-a-brac, decorative easels, curtain-poles, picture-frames, screen-frames, brackets, &c. The principal woods employed are ash, beech, birch, bass-wood, cherry, chestnut, elm, gum, hemlock, maple, oak, pine, sycamore, walnut, and whitewood.

B.—DOMESTIC ECONOMY: Woodenware and kitchen utensils, such as bowls or trays, rolling-pins, mauls or mashers, spoons, ladles, butter-molds, bread-boards, &c.; appurtenances of the laundry, as clothes-wringers, washing-machines, and mangles (birch, maple, and pine chiefly), clothes-pins (beech, birch, and white maple), clothes frames and driers (the same, with bass), washboards, tubs, and pails (see cooperage); mop-sticks, brooms, and carpet-sweepers, step-ladders, snow-shovels, and miscellaneous objects; refrigerators (the last in pine, spruce, walnut, ash, elm, bass, cherry, and whitewood).

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A.--HOUSE FURNISHING AND DECORATION.

Chairs.

Cane-seat chair, in white oak, red oak, black walnut, red birch, hard maple, white birch, cherry, and swamp oak, from Bodenstein & Kuemmele, 1342 North Front street, Philadelphia, Pa.

Music-stand.

One oak folding chair, and parts of other chairs in birch, maple, and black walnut; New Haven Folding-Chair Company, New Haven, Conn.

Chair exhibited from G. Henshaw, Elm and Canal streets, Cincinnati, Ohio.

Beautifully carved hall-chair, "Argosy," with sail, oars, and other nautical emblems; Bruschke & Ricke, Chicago, Ill.

Carved music-stand in cherry, from F. Wenter, 109 West Fourteenth street, Chicago, Ill.

Furniture.

Pine bureau and washstand, from George A. Brooks, Baldwinsville, Mass.

While we are apt to suppose that only a few kinds of wood are used in the manufacture of furniture, such as walnut, cherry, ash, oak, pine, &c., nevertheless a score of different woods are regularly used by the furniture manufacturer. In "parlor frames," chair-stock, and general furniture woodwork there are used, white ash, white oak, cherry, elm, birch, beech, chestnut, maple of several varieties, black walnut, sycamore, bass-wood, whitewood or poplar, pine, spruce, and hemlock.

The furniture industry, with its five thousand and more establishments, is a large consumer of lumber, the value of materials alone in a single year amounting to $35,000,000. Of this sum, perhaps 8 or 9 per cent. represents the manufacture of chairs alone, as there are nearly 400 such establishments turning out every grade of chairs, from a camp-stool to a "parlor frame."

A factory consuming three-quarters of a million feet of lumber in a year, and engaged in manufacturing the better class of furniture, such as hall suits, parlor frames, &c., will require in its plant about fifty machines for different uses, as rip and cross-cut saws, band and scroll saws, jointers, sand-paper machines, turning-lathes, molding and shaping machines, &c. Then, as the lumber must be thoroughly seasoned, there must be dry-kilns, besides storage-sheds for air-drying, so that capital of $50,000 to $250,000 may be invested in the industry. In the better class of manufactures the proportion of labor expended in the various stages usually runs up to nearly one-half of the value of products. That is, a pay-roll of $50,000 is necessitated in the producing of $100,000 worth of furniture. In the finer grades of furniture some foreign wood is used, chiefly mahogany, though walnut for certain uses may be almost as valuable at present scarcity.

All qualities of lumber are used in this manufacture, the majority of factories buying in the plank cut to sizes required. Very few concerns reduce from the log. The furniture industry is divided into specialties as in the manufacture of other products. There are a dozen or more different kinds of chair-factories; school furniture is another specialty; bedstead manufacture another, a score of factories turning out as many

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different forms and many of them patented. There are a large number of desk manufactories, the "roll-top" desk alone being made in nearly every Northern State. A firm in the State of New York that turns out over 2,000 desks a year, with a quarter as many office-chairs, employs 150 men, and requires a plant of over forty machines, besides two kilns, and all the machines are kept at work. Over 600,000 feet of lumber, chiefly cherry, oak, white-ash, black walnut, pine, and poplar are consumed in the year, about 20 per cent. only being wasted in manufacture. Chamber suits, parlor and hall suits, wardrobes, extension and other tables, lounges and sofa-beds, cribs and cradles are all made as separate specialties, some concerns making several, but very few establishments manufacturing a general line of all kinds of furniture. Then there are large establishments where no finished furniture is produced, but that get out furniture and chair stock. The dowel manufacturers furnish large quantities of this kind of product to the chair manufacturer, and even such smaller specialties are reported as extension table slides, turned legs, and bent stock, also used in chair manufacture.

In getting out sofa and chair frames, the rough boards or planks go through a planer; then to the markers, they designing according to pattern with pencil-marks the forms of pieces to be cut out; then the board or plank goes through the hands of men who attend to swing, rip, band, and jig saws; then the pieces go to turners, and to molding and sand-paper machines, wood carvers, &c., until all are properly prepared. In some concerns, as chair factories, the lumber, after having been sawed into irregular pieces, is taken to the kilns, to be thoroughly seasoned before fitting together. When the pieces are formed to the different shapes of the furniture for which designed, the cabinet-makers receive the single pieces, fit them together, and finish the whole frame for market; that is, the cabinet-maker receives those pieces which belong to the article he is making; for instance, all the material for two or four hundred chairs of same pattern and size, or twenty-five to fifty sofa frames of same pattern; and by this division of labor the low price of manufactured goods is explained. Each piece of wood may pass through a dozen hands and as many machines before going to the finisher; in fact, considerable furniture is never finished (stained, oiled, varnished, &c.,) at the factory, but sold as it leaves the sand-paperer, to be finished as desired by the retailer. As to parts of wood employed, some use the entire tree, while others reject the heart and sap wood, dependent upon kind of manufacture.

Moldings (picture).

A complete series of picture-moldings in spruce, butternut, locust, white birch, hickory, poplar or whitewood, bass-wood, elm, cedar, maple, chestnut, cypress, white pine, white oak, white ash, California redwood, dogwood, cherry, hemlock, white holly, sycamore, black walnut, pecan, and yellow pine, from Hall & Garrison, 1124 Washington avenue, Philadelphia, Pa.

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Venetian blinds.

One blind, in white ash, cherry, black walnut, and hard maple; F. H. Gile, Boston, Mass.

Embossed ornaments.

Set of compressed wooden ornaments, in a large variety of woods, donated by Albert Komp, New York City. These are used for decorating or ornamenting fancy cabinet work, furniture, &c.

B.—DOMESTIC ECONOMY.

Clock-cases.

Clock-cases in oak, ash, chestnut, and walnut; New Haven Clock Company, New Haven, Conn.

Clothes-wringers.

Clothes wringers, mangle, &c., white ash and birch; Metropolitan Manufacturing Company, Middlefield, Conn.

This company also manufactures other goods, spring mattresses, &c., though not represented. In the manufacture of clothes-wringers the wood frames are constructed of clean red birch and hard maple. Washing-machines, clear Michigan white pine; mangles, pepperidge, or gum for the rods, and sometimes maple; mop-wringers, ash for rods. A New York manufacturer states that lumber is usually seasoned three years.

Clothes-pins.

Samples in various stages of manufacture, from the Saratoga Clothes Pin Factory, Northville, Fulton County, New York. These are made wholly of white ash.

Other manufacturers use various woods, such as beech, white and black birch, and maple, nearly the entire tree from the butt to parts of the tree at over 4 inches in diameter. Log lumber, however, gives a better class of clothes-pins. In manufacture the log after being brought to the factory is cut into lengths 31 inches by circular cut-off saw; then to a bolting saw and cut into bolts the proper thickness; then to a gang of saws cutting them into sticks. They are then placed on a revolving drum, which carries them to gang cut off saw, which cuts them to the exact length of the pin; then they go by elevators to the turners, where they are placed in a shoe, the turner working automatically; they are turned to the proper shape, and from there go to the slotting-machine, are there placed by the operator in troughs, the machine picking them up and slotting them; they are then placed in a revolve-pipe drier, going thence to the polishing cylinder, then to the packer. Each pin passes though eight hands.

Another manufacturer states that after preparing the little blocks of wood 5½ inches long, they are placed on an endless belt which feeds the blocks automatically into the lathe. As the lathe is turned the pin is taken automatically from the spindle, and placed on a turn-table and carried around to a circular saw which whittles out the slot in the pin. It is then finished and thrown out of the turn-table by the same appliance that puts the pins in the table. Falling they are caught in a basket or barrel, and are then taken to the dry-house for twelve to twenty-four hours, or until dry. They are then taken to the polishing cylinder or

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rumbler, which holds 20 to 40 bushels; this is run at a slow speed, about thirty turns a minute for from twelve to twenty-four hours, and by simple friction and contact they become polished. In some manufactories the pins are dried and polished in a steam cylinder within another cylinder, having hot steam around all sides, except man-hole. They are next taken to the packing room, the packing being done by boys and girls, at about 1 cent a box of five gross, and expert hands have packed one hundred boxes in ten hours. While as a rule, makers use no coloring or staining, some blanch their pins before polishing. White birch makes the whitest and most salable goods. A single plant consists of board saw, gang splitter, gang chunker, turning lathe, drying-house and polisher; the value has been as high as $12,000 per set, now less than one-half. The cost of lumber is about one-third of value of pins.

Clothes-dryers and towel-racks.

Improved (bracket) clothes dryer manufactured from beech and birch. Three arm swinging towel-racks. Donated by C. A. Foster & Co., Fitchburg, Mass.

Towel-rolls, A. G. & J. C. Bemis, East Jaffrey, N. H. From cherry, whitewood, and black walnut. The process of manufacture is exceedingly simple.

Baskets.

Willow baskets were received from C. Goebert & Son, 56 North Second Street, Philadelphia, Pa.

Bread-boards.

Carved board for table use in white birch, A. J. and J. E. Bemis, East Jaffrey, N. H.

Matches.

Friction matches. Pine blocks in the rough, match-splints (the intermediate processes not illustrated) finished matches in variety. From the Diamond Match Company, West Haven, Conn.

A similar series of card matches were donated by the Boston Match Company, Boston, Mass.

It was impossible to obtain any information or statistics relative to this industry, as the different manufacturers jealously guard every process of manufacture. Michigan and Canada white pine, however, is used in this industry, the consumption running up into the millions of feet annually. When one extensive establishment reports a consumption of two to four millions of feet, we can form some faint idea of what a dozen will consume.

Step-ladders.

Specimen of step-ladders, out-of-doors clothes-dryers, and similar manufactures were contributed by Fellows & Day, 139 North Sixth street, Philadelphia. Woods used in their construction are oak, white ask, and basswood. Step-ladders are also made of pine and spruce.

Skewers.

Two bundles of machine-made hickory skewers, two sizes, were added to the collection by purchase. There are several skewer manufactories in the country, but neither replies nor specimens could be obtained from them.

Sweepers.

Crown automatic carpet-sweepers from black walnut lumber, donated by the United States Truck Company, Detroit, Mich. Carpet-sweepers are also made in all varieties of furniture woods.

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Toothpicks.

A collection of toothpicks, in basswood, was obtained by purchase. They are manufactured by machinery at comparatively trifling cost.

Washing-machines.

The Doty Washing-Machine Company, of Chicago, Ill., donated one machine, made of pine wood chiefly.

Butter-molds.

These are manufactured from hard maple, first turned to size and shape, and afterwards carved according to fancy.

Rolling-pins, potato-mashers, &c.

All these manufactures are turned from hard or soft maple, birch, or other close-grained woods; it only being necessary to have the lumber well seasoned, and free from knots or checks. Good white young growth is considered best for the purpose.

Trays and bowls.

A series of bowls were received from North Carolina (?), but were not labeled, and so cannot be properly catalogued.

Wooden bowls are made of cottonwood, elm, maple, and sycamore lumber principally, the best of the sawed timber being selected, clean and free from knots.

In manufacturing bowls the logs are cross cut into lengths equal to the diameter of the log. The cut is split into two pieces, cleaving out a bolt through the center, about 3 inches thick, to get rid of the heart wood. The bowl-blocks are then faced by a broad-ax and a hole bored in the center; then it is put into the end of a mandril, which draws it on and against a collar; it is then whirled around by shaft, and again faced by a facing-tool in the hands of the turner; next, the turner sets into position the largest crane and circle that the block requires. The outside portion of the block is then turned off by means of the quarter circle. The timber from the circumference to near the center and the part that falls off is called the scull. The back turner then turns the bottom, back, and rim of the block, which is the outside and bottom side of the bowl; this makes the largest size. The face-turner then sets into position the next smaller-sized circle, which enters the timber as before, thus cutting off the first bowl. The process is repeated until the block is all used up.

One manufacturer estimates thirty factories engaged in this industry, with an invested capital of $300,000, which is probably a high estimate.

VI.—USES OF WOODS IN ARTICLES FOR EDUCATION, CULTURE, OR RECREATION.

A far larger group than the preceding, it represents (with some notable exceptions) a large number of smaller or less important industries, although employing as great a range of material in manufacture. Pianos and organs, as far as their cases are concerned might be classed

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in the preceding group, but for the fact that their interior wood parts make them far more than mere pieces of house furnishing.

A.—SCHOOL APPARATUS: Globes, object forms, and drawing models; globe frames, in ash, beech, basswood, chestnut, birch, oak, maple, and black walnut; drawing boards, T-squares, rules; pencils and pen-holders; Kindergarten materials in wood; blackboards and pointers, map-rolls, &c.

B.—ARTISTS' MATERIALS: Sketching stools, easels, palettes (hard and soft woods), panels; cherry, holly, and firm-grained woods; maul-sticks, brush handles, stretchers, drawing boards, &c. Charcoal from willow is also used, though not from native woods.

C.—MUSICAL INSTRUMENTS: Pianos and organs, (interior parts in maple, spruce, sycamore, ash, pine, whitewood, &c.; cases of fancy furniture woods); violins (spruce, maple, and sycamore); banjos and similar instruments, drums (beech, birch, maple, and ash).

D.—GAMES AND AMUSEMENTS: Lawn-tennis racquets, croquet balls and mallets, base-ball bats, polo sticks, Indian-clubs and dumb-bells, checkers and chessmen, roulette boards, bagatelle and billiard tables, pitch and ring, and similar hoop games, employing nearly the whole range of available white woods.

E.—TOYS AND CHILDREN'S GAMES: Building and toy blocks, puzzle-blocks, carved and familiar object toys, rolling hoops, toy carriages, wagons and sleds.

A.—SCHOOL APPARATUS.

Object forms.

Under this head may be included object forms, geometrical solids, cubical blocks (to illustrate cube root), &c. These are manufactured from whitewood, beech, maple, bass, chestnut, oak, black walnut, and some other woods.

Among other school aids may be mentioned primary drawing models, as the cone, cylinder, double cone, spool, and prisms, in hard woods. Ellipsograph in maple. Primary counting blocks, rules, &c. The kindergarten "gifts," in various woods, should also be enumerated here; sphere, cylinder and cube; rock-maple cubes composed of eight, twenty-one, and twenty-four smaller cubes and blocks. Geometrical forms in light and dark woods. Sticks for stick laying, plain and colored. Hard-wood slats for plaiting work tiles, with pegs and holes for forming lines, angles, and geometric forms, &c.

Globes and globe mountings.

These are made of various hard woods, such as cherry, ash, chestnut, &c.

Drawing-boards.

Drawing-boards in white wood, Keuffel & Esser, New York City.

Drawing instruments.

These are T-squares, rules, circles, triangles, and similar goods. None represented. All hard woods, though most commonly of maple, cherry, oak, or mahogany.

Lead pencils.

One large case of pencils, illustrating manufacture from first to last (log, plank, slab, strip, pencil), from the American Lead Pencil Company, New York.

These are manufactured chiefly from cedar derived from the west coast of Florida, and received in logs measuring on an average 12 inches square and 12 feet long. The method of constructing a pencil is as fol-

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lows: The wood is cut into boards of about six widths of pencils and half the thickness of a lead pencil, dried by steam for about four weeks, grooved semicircularly (two boards, one for tops and one for bottoms) to fit around leads. These six-width slats are smeared with glue, the lead laid in the half grooves of one slab, and the other (bearing the other groove) placed over it. The two slabs are pressed together and left to dry, after which each pair of slabs thus glued together and containing six pencils is divided by a shaping machine into single pencils, then colored and finished. The "lead" is principally imported from Bohemia, is washed, mixed with clay to give it tenacity, squeezed through dies, macaroni-like, and burnt.

Regarding the supply of Florida cedar for this purpose, Mr. Curtiss says:

The favorite variety of red cedar, of tall straight growth, is becoming scarce, but there remains a large quantity of quality sufficiently good for pencils in nearly all sections of the State growth of a line drawn from Cape Canaveral to the north end of Charlotte Harbor. There is no red cedar in Southern Florida, the Dixon mill at Tampa having exhausted the supply within reach of that place; but new mills have been established near Webster, in Sumter County, and at the head of Crystal River, at present the best source of supply.

Mr. Henry D. Caruse, of the American Lead Pencil Company, makes the following interesting statements:

Because of lack of proper and adequate vigilance, many young trees are cut down, principally by trespassers, and used for inferior purposes (fence posts, &c.), consequently yielding a far less revenue to the country than if they had been permitted to attain their full growth, and then be offered in the markets for the arts and manufactures.

The present practice will eventually cause the extinction of this cedar. No tree less than 18 inches in diameter at the base of the trunk ought to be cut down. Even now Florida cedar is comparatively scarce, and recourse has been had to Alabama cedar, which is an inferior cedar, being more knotty, harder, and more difficult to free it of the oil than the Florida cedar.

The home consumption of cedar for pencils only cannot be less, at present, than 200,000 cubic feet, and in six months hence, when this company's new factory and machinery is ready, when we expect to turn out about 2,000 gross of pencils a day, the home demand will be about 300,000 cubic feet per annum. If to this be added an export demand of an equal quantity to the domestic consumption, as also what may be used for coffins, furniture, veneers, &c., the value involved is of no small magnitude. The lack of cedar would throw idle an invested capital of at least $5,000,000.

As the softness and aroma of the Florida cedar depends considerably, in the writer's belief, upon the swampy condition of the soil wherein it grows, care should be used that the cutting be not confined to any particular section, as by denuding the ground of the trees, not only the fall of rain would be less in that section, but the earth, being less sheltered, would become dry and sterile.

Pen-holders.

Wooden pen-holders in bass-wood, American Lead Pencil Company, New York City

B.—ARTIST MATERIALS.

Easels.

One cherry folding sketch-easel, from Keuffel & Esser, New York City.

These are all made in maple and other woods.

Common tripod easels, in pine and black walnut.

Studio easels (upright), mahogany, cherry, walnut, and other hard woods.

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Palettes.

Square, oval, and folding palettes, in bird's-eye and plain maple, black walnut, and mahogany, Keuffel & Esser.

Maul-sticks.

In walnut and cherry, the latter jointed, with brass socket and ferrule, Keuffel & Esser.

Sketching-stool.

One folding sketching-stool, in maple, donated by Keuffel & Esser. These are made also in ash and other tough woods.

Canvas-stretcher.

Patent pine stretcher for mounting canvas for oil painting, Keuffel & Esser. These should be made from boards cut directly across grain, and will then be free from warping.

Miscellaneous.

Color boxes, most commonly made from tin, are sometimes made of wood, such as cherry, mahogany, or any hard variety. Brush-handles, when made in this country, are of red cedar, pine, or white wood; panels for painting, cherry, or any close-grained wood that has been perfectly seasoned.

C.—MUSICAL INSTRUMENTS.

Pianos and organs.

One large case of panels and parts, representing the manufacture of pianos and organs, was donated by B. Schoninger & Co., New Haven, Conn.

Although some twenty different woods are exhibited in this case, the principal woods used are pine, spruce, whitewood, chestnut, maple, bass-wood, white ash, and black walnut. The frames or bed timbers (of an upright piano) are made of ash, and other interior work of maple. The sounding-board is of spruce (see below), while the pine and whitewood appears in portions of case and unimportant parts. Cases and ornamental work, usually walnut and imported woods; in veneers, other woods are used in the interior parts.

In the Schoninger factory the black walnut is used both in the solid and in veneers, and now comes mostly from Tennessee and the adjoining States. The ash is from Indiana; whitewood, from the Western States; bass-wood, from Michigan; maple, from Northern New York; chestnut, from New England. Nearly all the wood used is from first-growth timber, and the desirable qualities are clean, straight-grained stock, easily worked, free from gum, and having good resonant qualities.

Piano sounding-boards.

Admirable samples representing the manufacture of spruce sounding-boards were donated by Alfred Dolge, Dolgeville, New York.

Lumber for sounding-boards is very carefully selected, and air-seasoned for about a year, with six weeks of subsequent kiln-drying in dry-house at a temperature of not over 120° F. This slow process of drying is necessary for all sounding-lumber. After the lumber is planed and edged it is carefully assorted, matched, and glued into boards of an average size of 4 by 5 feet. The entire board is generally planed three-eighths thick.

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In this industry alone four concerns are engaged, employing about five hundred men and an invested capital of $200,000.

Mr. Dolge uses the best quality only of spruce logs, cut into quartered boards, 13 feet long, 4 to 8 inches wide, and five-eighths thick. The spruce is derived from Herkimer, Fulton, Lewis, and Hamilton Counties, in the Adirondack region of New York. In the Schoninger establishment the sounding-boards of both pianos and organs are made of three different kinds of wood, and glued together crosswise. This arrangement, it is claimed, prevents all cracking, shrinking, or swelling.

Violins.

Violins, and parts, donated by Charles F. Albert, 205 S. 9th street, Philadelphia.

This collection embraces violin and cello sound-posts of silver spruce; neck and sides of violin, curly maple; cello bridges of plain maple; bridges of sugar-maple; sides of curly sycamore. The process of manufacture, seasoning of lumber, &c., could not be obtained.

Banjos and tambourines.

Banjo and tambourine hoops, or rims. From beech, maple, and birch.

Logs sawn into planks, split in strips, planed, steamed, bent into shape, secured at laps, finished. All parts of the body of the tree are used that are free from knots, "curls," or other imperfections.

D.—Games and amusements.

Base-ball bats.

Series of base-ball bats in cherry, spruce, white ash, willow, and bass-wood. From Peck & Snyder, New York City.

The same, from H. Rademaker & Co., Grand Rapids, Mich. One set of bats in ash, maple, pine, and poplar. From A. G. Spalding & Bros.

Sawed to proper size, air and kiln-dried, turned on lathe, oiled or French-polished, painted, and branded.

Lawn-tennis racquets.

Racquet in white ash and California redwood. From Peck & Snyder.

In making a lawn-tennis racquet it is: First, sawed out of plank with a circular saw; second, planed with a surface-planer; third, steamed and bent; forth, kiln-dried; fifth; glued together; sixth; planed out of wind with an angle-planer; seventh, inside of rim cut on an irregular molder; eighth, handle glued and cut to shape on molder; ninth, sand-papered on wheel, and by hand-labor; tenth, holes bored for strings with machine; eleventh, French polished; twelfth, strung with gut string (lamb's), and then it is ready for market.

Polo mallet.

Sticks or mallets used in the game of polo, with horses, made from white ash. Peck & Snyder.

This is a small and narrow mallet-head into which is set, at at an acute angle, a long, slender handle. A "sling-stick" also accompanies the samples.

Horizontal bars.

Set of bars and trapeze in best white hickory, finished and polished. Peck & Snyder.

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Croquet set.

Balls, mallets, and posts in various woods. H. Rademaker & Co., Grand Rapids, Mich., two sets. A. G. Spaulding & Bros., one set.

The balls are turned from thoroughly-seasoned rock-maple; mallets, rock-maple heads and white-ash handles, apple-wood sometimes being used instead of rock-maple; posts, ash. Second-growth lumber chiefly used.

Indian clubs.

Pair of highly polished rock-maple clubs. H. Rademaker & Co.
A second pair, from Peck & Snyder, New York.
Set of clubs in whitewood. A. G. Spalding & Bros.

Dumb-bells.

Set of hard-maple dumb-bells, from Peck & Snyder. These are made from second-growth lumber, thoroughly seasoned by air and kiln-drying. The dumb-bells were accompanied with set of wooden rings for light calisthenics.

Checker-men.

Maple checker-men, plain and colored. De Witte C. Lockwood, Derby, Conn.

Lumber sawn to bolts 18 inches long, and slightly larger than diameter of checkers; machine-turned and polished; sawn into blanks, thickness of checkers ($\frac{3}{8}$ of an inch), placed in revolving cylinders to polish and remove splinters and chips; run through embossing machine under powerful pressure, which stamps out and finishes the men. Stained, painted, sorted, and packed in boxes. Require about eight operations.

A cherry checker-board and set of checkers in maple were also presented by the Milton Bradley Company, Springfield, Mass.

Billiards.

Parts of billiard tables from the Brunswick-Balke-Collender Company, New York.

This series of illustrations of billiard-table manufacture includes one end rail of white oak, with black-walnut panels; one side of rail of white ash and oak, inlaid with panels of cherry root, blister walnut, ash burl, walnut burl, Kentucky wahoo, California redwood; also, one cue in white ash.

Miscellaneous.

Pitch-a-ring, magic hooks, and ring games. Milton Bradley Company, Springfield, Mass.

The boxes are of chestnut, posts of maple, and hoops or rings of rattan.

E.—CHILDREN'S TOYS.

Blocks.

Building-blocks in bass-wood. Milton Bradley Company, Springfield, Mass.

The Milton Bradley Company also manufacture a large series of puzzle-blocks, letter-blocks, and similar toys, chiefly bass-wood and cherry. Bass is well adapted to toy manufacture, because it contains no pitch, and therefore glues well, works easily, and the absence of pitch avoids soiling paper that is pasted on blocks.

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Toy horses and carts.

Small horses and carts, the former of bass-wood and the latter of elm, birch, and bass-wood. A. B. Ruggles, Birmingham, Conn.

These are made from the best quality of lumber, the bass-wood obtained from Michigan, although nearly as good quality can be obtained in New York and other States. The other woods are obtained in Connecticut.

The plank is first planed, then rough-shaped by band-sawing, carved by hand, sand-papered on wheels and belts, glued and nailed, the different sections together, painted, trimmed, and packed. Machines in use, planer, band and table saws, swing-saws, variety and common lathes, borers, sand-wheels, belts, &c. Value of plant, about $10,000. Proportionate cost of labor to full cost of production, about 66⅔ per cent. The bass-wood is peculiarly adapted for making toy horses or other articles where small portions or angles stand out (like the ears and legs of horses), on account of its tenacity or toughness, and at the same time light weight and easy working quality. No special treatment required. Each article is handled about twenty times before ready for shipment.

The plank used for horses is cut up in short lengths for convenience, then taken to the band-saw and sawed into rough outline shape, thence to the carver, then to sand-wheel for smoothing off ready for painting. The hubs to wheels are turned in variety lathe, which bores and shapes them at one operation, from square stick, at a rapid rate.

Toy drums.

Toy drums in bass-wood, maple, and cherry.

In making a toy drum the log is blocked off the length that is required for the circumference of the drum, put into a revolving cutting-machine, which reduces to the thickness required for the shell of the drum, then to a scraping-machine, which takes the ends to a beveled joint ready for steaming, then taken to the bender, where several sizes are bent in one nest, dried, laps glued, then smoothed on a small wheel or belt, then taken to the paint-room, where ornamented, varnished ready for the heads. The heads tucked round a small hoop to hold them in place, snares put on, then drum put into a press, where the hoops are pressed on, cord and tightening straps put in place, all ready for packing-room, then put into cases that hold from four to twelve dozen each. At least fifteen distinct operations from rough lumber to finished drum.

Toy tables and chairs.

Toy furniture, from the Converse Toy and Woodenware Company, Winchendon, Mass. The firm also donated examples of drawing and blackboards for children's use.

Bow-guns.

A specimen of bow-gun in white-wood, from Peck & Snyder, New York City.

One toy spring-gun in bass-wood. Milton Bradley Company, Springfield, Mass.

Toy express-wagons, &c.

Specimens of manufacture from Tricycle Manufacturing Company, Springfield, Ohio.

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VII.—Miscellaneous uses.

In this provisional group may be placed such wood manufactures as cannot properly be classed with any of the preceding, such as gun-stocks, wooden shoes, artificial limbs, crutches, canes, surgical appliances in wood, &c.

Gun-stocks.

The Whitney Arms Company, of New Haven, Conn., presented a series illustrating the manufacture of gun-stocks from the rough-sawn plank to the finished stock.

E. Remington & Sons, Ilion, N. Y., who were asked to make some statements regarding this industry, reply that the best walnut for gun stocks comes from Ohio, Missouri, and Tennessee, being received in the form of second growth 1 and 2 inch plank and one-sixteenth veneer. The firm used over 1,000,000 feet of walnut, cherry, oak, bass-wood, ash, and pine per year, one-third being walnut, the other woods being used for cabinet-work and boxing-lumber.

The operations upon a plain gun-stock for the Springfield rifle may be enumerated as follows: Rough sawing; cutting off butt and tip ends; marking four points in butt end and one in tip end for fastening in turning-lathe; turning tip and butt; spotting (or by means of a circular-saw gang marking places on each side of butt and tip, and several on one side of the stock between the head and tip, as a guide for additional operations); cutting barrel-groove; cutting for receiver and tang and tenon of breech-screw; finish cutting barrel-groove; squaring tenon mortise; planing sides and edges of stock to a former; sawing off butt and tip to gauge length; cutting butt-plate curve; bedding butt-plate tang; boring and tapping for butt-plate screws; bedding for lock-plate; boring for tang of sear and for bridle and sear screws; cutting recesses for main-spring bridle, tumbler, and sear-spring; countersinking for head of bridle screws; bedding for guard-plate; boring for guard bow-nuts and trigger-stud; cutting mortise for blade of trigger; boring hole for guard, tang, and side screws, and counterboring for side screw-washers; finish cutting top, upper, and lower bands, and between bands, and forming shoulders for bands, and shoulders and tenon for tip; finish turning from heel of butt to head and from head to lower band; bedding for ramrod-groove and stop and forming holes for studs; cutting recesses for the band-spring and boring holes for their tangs; boring ramrod groove; cutting barrel-groove for receiver; cutting groove for arm of hinge-pin; boring hole for tip-screw; finishing with hand-shaves, scrapers, and sand-paper and oiling with linseed oil. These last few hand operations require about five-eighths of the labor upon the stock, all the varied and curious cuts made by machinery requiring only three-eighths, which is a very forcible exhibit of the value of labor-saving machinery. The enumeration of the foregoing operations outlines a complete system of manufacture which has, since 1820, been gradually evolved from the whittling, boring, and chiseling by hand, which then constituted the single craft of stocking.—[Manufacture of fire-arms, Tenth Census Reports.

The following is given concerning the processes of manufacture by the Remington Company:

Two-inch plank is first cut up into the rough-shape gun-stocks, and each stock is profiled, that is brought down to a uniform rough state, when it is placed in the butt-plate milling-machine, and the end of the stock prepared for putting on the butt plate. Having thus got an exact starting point, the stock is sawn off to the required length, and the opening is made for letting in the system or frame, after which the

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long groove in which the barrel lies is cut and edges of it beveled off. The stock is then turned to the required shape, and the tip-iron is put in place, which finishes the machining part of the manufacture of the gun-stock. The remainder of the work is done entirely by hand and with the use of the usual tools. The entire time required from the moment the rough plank goes under the saw to the completion of the machining is about forty minutes.

Artificial limbs.

One sample willow lumber, with leg carved in relief; artificial limbs in parts and complete, from A. A. Marks, 691 Broadway, New York.

Mr. Marks states that artificial limbs are also made from bass-wood. Most of the wood used comes from Fairfield County, Connecticut, only thrifty, large trees being selected, the trunks alone being used. The wood is secured in winter. Bass-wood from Ohio and willow grown in New York State have also been used, but they find no superiority over the Connecticut-grown lumber. From the irregular shapes and hollow forms of limbs the waste often amounts to 90 per cent., the lumber costing from $150 to $200 per thousand feet. It comes to the factory in blocks 4 to 8 inches square, and from 1 to 4 feet long, bored out in the center when green, and seasoned for three years. It is also stated that American willow and bass-wood are not excelled for this purpose by any of the many foreign woods that have been experimented with. The different processes of manufacture are interesting. The tree is cut into lengths of from 1 to 4 feet, split into square pieces of from 4 to 8 inches, dressed on a circular saw, bored the entire length with 1 or 1½ inch auger, allowed to season in a dark, dry place for from two to three years. Carved into shape, hollowed out to a thickness, smoothed outside and inside, hooped to give it additional strength, covered outside with buckskin, a water-proof coating applied to the covering. Inside of leg is smoothed and polished. Feet are made by carving a block of willow wood into the shape of a small last of about two-thirds the diameter of the natural foot; about this sponge rubber is vulcanized, alternated by layers of canvas. Some of the wood-work is done by grinding and sand-papering machines, otherwise the work is done by hand. The leg will pass through at least a dozen hands before finished.

There are about fifty manufactories of artificial limbs in the United States; capital not estimated.

Wooden shoes or sabots.

A number of pairs of wooden shoes were presented by Felix Marston & Blair, 55 South Water street, Chicago. No information could be obtained as to woods employed or processes of manufacture.

Crutches.

Several pair of crutches in white ash and maple, from Nathaniel Wilton, Franklin, N. H.

Mr. Wilton states that of native woods cherry and birch are also used, and of foreign woods, lancewood and rosewood. The native woods are second-growth lumber, obtained mainly in New Hampshire and Vermont.

First saw the lumber into strips five-eighths by seven-eighths; these

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are planed, and some kinds steamed and bent in molds; a spoke-rounder is used to round them, after which they are finished on a sand-belt, two pieces glued together at bottom; nickel-plated trimmings put on, with rosewood handles and leather tops. The cheapest kinds are turned in a lathe, split down within 10 inches of end, a rivet put through at end of split handle and wood top put on.

Messrs. Augustus Beckel & Son, 30 North Sixth street, Philadelphia, presented crutches made of white birch, white ash, and hard maple.

Umbrella-sticks and canes.

A large case was presented by Montgomery Ford, 1028 New Market street, Philadelphia, Pa.

Canes are shown in ash (with and without bark), Florida orange, peg-wood, oak, tea-berry, hard maple, swamp huckleberry, birch, iron-wood, and dogwood. Umbrella-sticks were shown as follows, the first mention referring to shank, the second to handle: Maple, maple; maple, apple; maple, stramonium; birch, birch; maple, oak; maple, alder; maple, Florida orange; dogwood, dogwood.

Pine hair, &c.

Samples of manufactures from the long-leafed pine (*Pinus australis*) of North Carolina. Presented by the Acme Manufacturing Company, of Wilmington.

Raw material; one sapling (trees attain a height of from 60 to 100 feet); one bag of needles. Manufactured products; three grades, A, B, and C.

Pine hair for upholstering purposes, being clean and sweet, and so prepared as to preserve the balsamic odor; one bag, grade D, substitute for hair in plastering; one sample real pine hair; one bag of pine wool; one bottle pine burr oil; one bag pine dust (as a fertilizer, said to contain a high percentage of ammonia), and one bottle of pine oil.

The pine wool is claimed to be the nearest approach to natural wool ever made from vegetable fiber, and it is intended for spinning and weaving into mattings and carpets. "It takes and retains dyes without a mordant." The manufacturers also claim that the pine oil is a valuable medicine and antiseptic. "The well-known properties of the needles of the long-leaf pine, as containing carbolic acid, tannin, and creosote, are here preserved with a sweet, balsamic odor." The manufactured products are said to be "vermin proof."

Chemical products.

Into this group has been classed a variety of manufactures, obtained wholly or in part by chemical treatment of wood, and including charcoal, wood-pulp, bark extracts, and other products of wood that undergo at the same time certain mechanical manipulation.

Charcoal.

Samples of ordinary pit charcoal.

In reply to queries regarding the manufacture, Mr. S. L. Griffith, of Derby, Vt., gives the following interesting information:

Timber used is chiefly birch, beech, maple, spruce, and hemlock, the lower portion of the tree being used as lumber, and all remaining portions cut into cord-wood and subsequently burnt in charcoal pits. It requires twelve days to char the wood and six days to cool. A cord of dry hardwood yields 50 bushels (2,688 cubic inches each),

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green hardwood, 42 bushels. Dry spruce and hemlock wood yields 75 bushels; green, 60 bushels. Margins are very small to-day, as it costs 6¼ cents to make and deliver coal into cars, and sells for 6¾ to 7½ cents.

In a recent article in Outing on "The charcoal-burners of the Green Mountains," the following interesting statements are given:

The walls of the kilns are 12 inches thick and the kilns from 25 to 30 feet in diameter, 12 feet high to the crown, and about 7 feet crown, with a circular opening in the crown of 5 feet diameter. The only other opening (except the vents) is the door, which is closed by a heavy slab of No. 8 iron. The floor is of clay and well tamped, and the foundations are thoroughly grouted before the structure is commenced, as the kilns expand with the heat and contract while cooling. There are three tiers of vents or openings the size of a brick left in the walls for the purpose of drawing the fire back and forth—one hundred and twenty vents to each kiln—and they are called "waist, knee, and ankle vents."

In preparing a kiln for firing, a foundation of logs is first laid upon and covering the floor, except a fire arch from the door to the center. Then the logs are piled as above described, until the kiln is full, when the center is filled with kindling, and the pile is ready for firing. A rag saturated with kerosene is attached to a pole, and, being lighted, is thrust under the fire arch to the center, igniting the soft kindling; the door is closed and hermetically sealed; the thimble, or iron circular plate, placed over the opening at the top, and for ten or twelve days the process of charring goes on, being regulated by the vents around the base of the kiln. It is necessary that the fire should begin at the top and burn downward, and for this purpose two openings are left in the thimble at the top, each of which is easily covered with a brick. These are left open or closed, as emergency requires, and the vents are opened as needed, to draw the fire downward through the pile. When the wood is sufficiently charred above these vents, which is ascertained by the smell of the smoke, or by thrusting a bar into the vents, to feel whether it is wood or coal, the knee, or middle row of vents, and the ankle vents, are opened in succession, although the lower vents, as a general thing, are not opened, the collier preferring to burn the lower tier of logs in another kiln rather than run the risk of over-firing.

The kilns have a northern exposure, and when the wind is from that direction great care is necessary not to burn too fast. When it is from other quarters the burning is more regular. Sometimes a sink occurs, which means that the fire is drawn down too rapidly, leaving a middle portion uncharred. This is to be avoided, and can only occur through the carelessness of the collier. After the charring operation is complete the vents are stopped, the body of the kiln is thoroughly whitewashed, and the crown covered liberally with coal-tar, to make everything air-tight, and the kiln left for two days to cool off. It is then opened, and the coal can be taken out immediately. Thus it requires fourteen days at least to burn a kiln; two to fill, ten to burn, and six to cool. The secret of good coal, however, is to take time, and it is preferable to give it twelve days to char.

Wood-pulp.

Series of samples illustrating manufacture of wood-pulp, from the American Wood-Paper Company, Manyunk, Pa. Samples 1, 2, 3, poplar chips; 4, 5, and 6, unbleached paper pulp; 7, 8, and 9, bleached pulp; 10, unbleached paper; 11, bleached paper; 12 and 13, card-board and writing-paper. These samples represent the soda process of manufacture.

Samples from Herkimer Paper Company, Lyons Falls, N. Y.: 1, moist poplar pulp; 2, spruce pulp; 3, poplar wood; 4, poplar pulp, dry; 5, spruce wood; 6, spruce pulp, dry; 7, steamed spruce wood; 8, steamed spruce pulp, dry.

Pine, spruce, poplar, balsam-fir, and bass-wood are all reported as used in the manufacture of this product, and as a rule the best quality

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that can be secured. It is cut into cord-wood, usually in the winter, though some manufacturers say all seasons of the year, and one in May to August, when the bark will slip easily.

A New York State manufacturer gives the following processes of manufacture:

We first cut up the wood in a machine (which cuts diagonally across the grain) after being thoroughly peeled and cleaned. Then put in upright boilers (6 by 22 feet) which hold two and one-fourth cords; then boil it in strong alkali twelve hours; then separate cellulose from liquor, and wash the former and then bleach white, and run over a paper-machine, and make it into rolls, for market. The liquor we take to evaporating furnaces and recover the alkali to the extent of about 83 per cent. We pass this stock through eight rooms or processes. Use 60 to 70 tons coal per day; employ 120 men at mill. The actual cost for labor in mill is about 15 per cent.

A Vermont manufacturer writes as follows:

We cut the log or stick in blocks on a circular saw, cut bark off with a barker (similar to a stave or shingle jointer) split it up and take out knots, and put it into a grinder which grinds off the fiber. It goes to a screen-plate which sifts out the slivers, and the rest goes to a wet press which takes the pulp up on a roll, from which it is taken off in sheets averaging one-eighth inch thick.

From a Massachusetts manufacturer:

Chipper to cut into chips one-fourth inch long, steel digester 7 feet diameter, 24 feet long, to disintegrate the fiber, by use of chemicals and 120 degrees steam. We use ordinary paper-beating engines to reduce pulp.

The following letter from Howard Lockwood, Esq., editor and publisher of the Paper Trade Journal, New York City, is of interest:

NEW YORK, *January* 22, 1885.

MR. CHARLES RICHARDS DODGE:

DEAR SIR: I am in receipt of your favor of the 17th instant, and in answer to your question as to the number of factories in the country engaged in producing wood-pulp and wood-fiber, I send you by same mail the section of my Directory of Paper Trade for 1884. This will give you all the pulp-mills in operation and idle, and a full description of each. I have no statistics which will enable me to even approximately tell how much capital is invested in this particular branch of the paper industry.

According to tabulations made from this edition of my Directory, there was a producing capacity of chemical fiber in 1884 of 576,000 pounds daily, showing an increase over 1883 of 20⅛ per cent.; of ground wood-pulp there was a producing capacity of 795,550 pounds, showing an increase over 1883 of 25½ per cent. The above figures show the producing capacity of the mills, and, as a rule, should be considerably discounted, when considering the actual output; but, in view of the fact that these statistics do not include a large amount of fiber and pulp which are made at paper-mills in connection with the paper-making plant, and consumed on the spot, I should conclude that the capacity above named represented very fairly the actual production of these two products.

In reference to the question No. 16 of the inquiry circular, and bearing upon the forestry question, I would state that it takes a cord of wood of the kind used—poplar and spruce—to make 1,000 pounds of chemical fiber, and a cord of wood produces about 1,200 pounds of ground wood-pulp; therefore, you will see, by figuring on the basis of the above statistics, that it takes about 1,240 cords of wood to supply the mills of the country in producing their daily product; or, to produce a yearly output, will consume 369,000 cords of wood.

I would also call your attention to the fact that all of this wood, used for making fiber and pulp, has to be peeled and trimmed of all projecting knots, and in this way it represents a very large destruction of forest growth annually.

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We have given considerable attention in this office to the question of the destruction of forest alongside of steams, and the effect of the same in diminishing water supply. I think beyond a doubt to this cause may be attributed the failure of many of our smaller streams in the Eastern States, and this whole question is one of vital importance to the country at large.

I remain, yours truly,

HOWARD LOCKWOOD.

The Directory to which reference is made shows a list of about 175 mills in the United States and Canada. Two mills are given in Louisiana which manufacture pulp from bagasse of sugar-cane, and one in Florida from palm fiber.

Rosin and turpentine.

Collection of pine products prepared and donated by W. G. Clarke, Chickasabogue, Ala.

Section of pine tree (showing boxes and scarifications).

Crude turpentine, from box.

Green turpentine (taken from face of tree at close of season).

Sprits of turpentine.

Rosin C, strained; rosin D, good strained; rosin E; rosin F; rosin G; rosin H; rosin I; rosin K (low pale); rosin M (pale); rosin N (extra pale); rosin W. G. (window glass); rosin W. W. (water white). Dry distillation of pine knots and light wood, specimens as follows from some source: Pine knots, light-wood splints, tar (ordinary process), charcoal (made in retorts), crude pixine, pixilic acid, refined pixine, oil of tar, navy pitch.

Miscellaneous products as follows: Rosin oil, rosin varnish, brewer's pitch, pine cones (natural state), pine cones dipped in rosin, pine leaves prepared for mattrasses.

The accompanying letter from Mr. Clark will explain the collection of pine products enumerated above:

CHICKASABOGUE, ALA., *May* 8, 1885.

CHARLES RICHARDS DODGE, Esq.:

DEAR SIR: Your favor of 4th instant is just to hand, and I hasten to reply. I return your circular sent, filled, as far as I can do so, with regard to the, manufacture of lumber at this point, but think it better to answer your special inquiry in this separate communication.

My exhibit at the New Orleans Exposition is comprised (or was so intended, but it is not arranged exactly as I intended) in three sections or divisions, the first representing the product from the ordinary distillation of the crude turpentine as gathered from the pitch-pine or turpentine tree; the second the products from destructive distillation of pine knots or light-wood; the third the products resulting from the combination of the products from the two processes mentioned and articles made from the leaves of the pine tree.

In the first section I showed sections of the pine as boxed and wounded or chipped, to stimulate the run of the sap, including specimens of one, two, three, and four years working, the latter having its long faces covered with gum turpentine or scrape, the accumulation of the latter part of the season, when the nights become cool and checked the flow of crude to the boxes. In this division I furnished specimens of the crude turpentine as taken from the boxes, showing the virgin dip, the old dip, and the gum turpentine or scrape, in separate jars. I also exhibited spirits of turpentine and the various grades of rosin from "C," the lowest grade I make, the "window-glass," the highest grade I manufacture. In the second division I supplied a bundle of pine knots, which are found scattered all through our pine woods, and, before my process was discovered, were left to rot and waste, except such as were

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used for kindling-wood. I also sent a bundle of light wood or rich fat pine, cut in billets, as we prepare it for the retorts. We use the knots and split light wood indiscriminately in the retorts, and the richer the wood the more valuable is the product.

The wood, when prepared properly, is placed in iron baskets holding about half a cord each, which are let down into the iron retorts, the caps put on, and luted; then fire is started in the furnace and kept up until sufficient gas is produced, by which the firing may be continued, or until the process is completed. For this firing ordinary pine wood is preferable, although we frequently use knots or light wood. These are, however, objectionable, as they tend to fill up the flues and interfere with the draft. But to return to the exhibit: the products of this distillation are tar, charcoal (which is much heavier and richer than the kiln-burnt coal and will even answer for welding iron), crude pixine, pixilic acid, refined pixine, and oil of tar, which is pronounced superior to that article produced in the ordinary way.

In the third section I had navy pitch, rosin oil, rosin varnish, specimens of pine burrs in their natural form and also dipped in hot rosin (these were, of course, only as curiosities, not claiming any value); pine mast or seed, and specimens of vegetable hair or wool, made from the leaves of the pine and used for upholstering mattresses, &c. This last article I procured from North Carolina for the exhibit, and I do not know the secret of the preparation.

The special products of this destructive distillation (or retort processes) are comparatively new. Their valuable properties were discovered by myself and others who experimented with them, but they have stood the test of experience and are acknowledged to be very valuable for many purposes, especially deodorizers and disinfectants, for which purpose the pixine has no superior. I send you, as suggested, some printed circulars explaining the uses and character of the pixine and pixilic acid. The demand for the article is growing and its reputation extending, although it has not been advertised and no attempt has been made to attract special attention to its merits. A large portion of the acid now goes to waste, as it will not bear, in its liquid form, the exposure of distant transportation, but it is my design to enlarge the works and prepare to convert the acid into various articles of commercial value and large use. By chemical combinations I can make with it acetic acid and nearly all the acetates known to commerce or used by manufacturers. Indeed, the variety and extent of valuable products attainable under this process are truly wonderful, and not the least wonderful thing about it is that the basis of all is, in this section at least, waste material in most part absolutely worthless, gathered for this purpose, and therefore costs only the labor of gathering and conveying to the retorts.

With these works completed, as I desire, I could furnish acetate of lime at a cost which would defy foreign competition and, if the quantity were sufficient, stop the large importation altogether. The pixilic acid, which is only made from pine knots and fat light wood, differs from the ordinary pyroligneous acid in that it is much richer and heavier, contains larger proportions of tar and creosote, and is therefore a better disinfectant and preserver of wood.

Shingles or planks saturated in it are fire-proof, and I have used the acid with wonderful effect in extinguishing fires. Pixine, on the contrary, is very inflammable, but is not explosive. A notable characteristic of the charcoal is its dryness and freedom from dust; a lump of it may be taken up with white kid gloves without soiling them. But I fear I am becoming too prolix on this topic, and less I trespass too much upon your time and patience I will stop, subscribing myself,

Very respectfully, yours,

W. G. CLARK.

From the Report on Maufactures, Tenth Census, the following statements relative to the turpentine and rosin industry are taken:

The naval stores manufactured in the United States are principally produced from the resinous exudations of the long-leaved pine (*Pinus palustris*), and in small quanti-

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ties from the loblolly pine (*Pinus tæda*), and the slash pine (*Pinus cubensis*) of the Florida coast. The trees selected for "boxing" are usually from 12 to 18 inches in diameter, although trees with trunks only 8 inches through are now sometimes worked. A deep cut or "box" is made in the trunk of the tree by a cut slanting downward, some 7 inches in depth and generally 12 inches above the ground, and met by a second cut started ten inches above the first and running down from the bark to meet it. In this manner a segment is removed from the trunk, and a triangular trough formed 4 inches deep and 4 inches wide at the top.

The boxes are cut early in November with a narrow-bladed ax specially manufactured for the purpose, and the trees are worked on an average during thirty-two weeks. As soon as the upper surface of the box ceases to exude freely it is "hacked" over and a fresh surface exposed, the dry resin adhering to the cut having been first carefully removed with a sharp, narrow steel scraper. The boxes, especially after the first season, are frequently hacked as often as once a week, and are thus gradually extended upward until upon trees which have been worked during a number of seasons the upper surface of the box is often 10 or 12 feet above the ground. For these long boxes the scraper is attached to a wooden handle, generally loaded with iron at the lower end to facilitate the operation of drawing down the resin. Once in four weeks, or often less frequently, the resin caught in the bottom of the box is removed into a bucket with a small sharpoval steel spade attached to a short wooden handle. The product of these "dippings," as this operation is called, is placed in barrels and transported to the distillery. The first season a turpentine orchard is worked boxes are usually dipped eight times, yielding an average of 300 barrels of turpentine to the crop. The second year the number of dippings is reduced to five, the product falling off to 150 barrels, while for the third season 100 barrels are considered a fair yield from three dippings. To this must be added the yield of the "scrapes," which for the first year is estimated, for one crop, at from 60 to 70 barrels of 280 pounds each, and for succeeding years at 100 barrels.

The following grades of turpentine are recognized in the trade: "Virgin dip" or "soft white gum turpentine," the product the first year the trees are worked; "yellow dip," the product the second and succeeding years, and becoming darker colored and less liquid every year; "scrape" or "hard turpentine," the product of the scrapings of the boxes.

Rosin is graded as follows: "W," window glass; "N," extra pale; "M," pale; "K," low pale; "Q," good No. 1; "H," No. 1; "G," low," No. 1; "F," good No. 2; "D," good strain; "C," strain; "B," common strain; "A," black.

Tar, produced by burning the dead wood and most resinous parts of the long-leaved pine in covered kilns, is graded as follows: "Rope yellow" or rope-makers' tar, the highest grade produced with a minimum of heat from the most resinous parts of the wood; "roang," or "ship smearing," the next running of the kiln; "black" or "thin," the lowest grade, made from inferior wood or the last running of the kiln, and therefore produced with the maximum of heat.

Miscellaneous.

Collections of J. A. Mathieu, Detroit, Mich. Case 1, three samples, oak, chestnut, and dogwood lumber. Case 2, five samples of charcoal from dogwood and chestnut. Case 3, two samples acetate of iron, black liquor, and two samples pyroligneous acid.

Collections of J. S. Young & Co., Hanover, Pa., and Baltimore, Md. Boston Dyewood and Chemical Company, selling agents:

Quercitron bark liquor.

Quercitron bark extract.

Flavine.

Raw bark (*Quercus tinctoria*).

Rossed bark (*Quercus tinctoria*).

Collections of B. P. Clapp & Co., Pawtucket, R. I.:

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Birch, maple, and oak wood, crude naphtha, wood tar, pyroligneous acid, pyrolignite of iron, oak charcoal, birch charcoal, maple charcoal, acetic acid, methyl alcohol, brown acetate of lime, gray acetate of lime, pyrolignite of lead, brown sugar of lead, acetate of alumina, acetate of lime.

Model of still used in dry distillation of wood: German, Smith & Co., Winchester, Va.

Black-oak bark, raw; black-oak bark, rossed; A No. 1 coarse-ground quercitron bark; A No. 1 fine-ground quercitron bark; A No. 1 fine-ground sumac.

Sumac leaves, as gathered and cured for grinding.

Waste from grinding sumac.

Small miscellaneous collection of Canada balsams, oil balsam of fir, oil hemlock, oil white cedar, and oil spruce.

L. Crawford & Co., Chase Lake, N. Y. Rossings, ground bark; spent-bark extract; raw bark (hemlock); rossed bark (hemlock).

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APPENDICES.

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APPENDIX I.

PRICES OF LUMBER.

The following tables and figures give approximately the average of prices paid for lumber per 1,000 feet board measure, by manufacturers of the industries represented, in the various States where factories are located, from Maine to Minnesota. To these figures are appended statements regarding increase in cost of lumber in ten years:

Sash, doors, and blinds.

Woods.	Lowest.	Highest.	Average.	Location of manufactories.
Ash	$20 00	$25 00	$21 00	New England States and North Carolina.
Birch	8 00	65 00	50 00	New England, Illinois, and Minnesota.
Cherry	20 00	50 00	40 00	New York and Vermont.
Oak (white)	20 00	25 00	21 00	New England and New York.
Black walnut	30 00	180 00	100 00	New England and North Carolina.
White pine	10 00	50 00	30 00	New England, New York, Pennsylvania, Illinois, and Minnesota.
Yellow pine	5 00	15 00	10 00	North Carolina.
Poplar	12 00	40 00	35 00	New England States.
Spruce	14 00	18 00	15 00	New England.

A factory in Vermont quotes beech at $7 per M, and one in New York gives maple at $20. Hemlock is quoted in North Carolina at $12. House finish and moldings average about the same prices.

Building lumber.—But few returns were received relating exclusively to building lumber, principally from the New England States, where prices are quoted as follows: White pine, $8 to $14; yellow pine, $5 to $14 (Southern); spruce, $15 to $18. In Minnesota all kinds of rough house timber costs about $9 to $15 per M.

Shingles.—These figures are quite incomplete, as no returns were received from Michigan and other localities from which a large proportion of the shingle product is derived. The replies are from the Northern New England States, New York, Pennsylvania, and Southern States from Virginia to Alabama:

Woods.	Lowest.	Highest.	Average.
White pine	$5 00	$15 00	$10 00
Spruce	8 00	12 00	9 00
Hemlock	4 00	10 00	8 00
Cypress			10 00
Cedar	12 00	15 00	13 00
Cedar from Dismal Swamp	15 00	18 00	17 00

Mosaic and parquet floors.—Usually high-priced lumber used: White ash, $30 to $60 per M; white birch, $60; cherry, $40 to $80; maple, $65; white oak, $35 to $80; and black walnut, $120.

Moldings.—Insufficient returns to make a reliable average of prices, though the replies received indicate considerably lower prices than those given for parquet flooring woods.

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Car-building.—No figures could be obtained from the railroad companies or others engaged in building cars. Street-car lumber ranges in prices as follows: White oak, $40 to $50; white ash, $35 to $45; poplar, $30 to $45; white pine, $20; and yellow pine, $40 per M.

Carriage-building.

Woods.	Wheel parts.			Carriage parts.		
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.
Hickory	$15 00	$85 00	$49 00	$18 00	$100 00	$46 00
White oak	15 00	45 00	30 00	18 00	60 00	35 00
White ash	15 00	40 00	24 00	28 00	60 00	46 00
Elm	10 00	70 00	35 00	.....	.....	.....

Panels.—Basswood, in thick veneers, $20 per M.; poplar boards, average of $35; birch timber, used for hubs in New York to a very limited extent, $10 per M. In harness parts: Hames, ash, $30; oak, $30 to $60; hickory, $60; elm, $30. Saddle-trees, oak, ash, poplar, beech, gum, &c., $10 to $20.

Ship-building.—Prices in the table include all kinds of timber used in constructing boats, steamboats, and ships. Red oak, not given in the table, averages $25 to $30. Hackmatack, $18 (in Maine). Table of prices for ship-timber is as follows:

Woods.	Lowest.	Highest.	Average.
White oak	$18 00	$40 00	$31 00
White pine	25 00	70 00	41 00
Yellow pine	22 00	26 00	25 00
Spruce	20 00	40 00	26 00
Cedar	20 00	50 00	32 00

Returns made from ship-yards and boat-building establishments in Maine, Massachusetts, Rhode Island, Connecticut, New York, Delaware, and Ohio.

Telegraph-poles.—About $12 per thousand feet for all kinds; the best poles are of cedar.

Tool-handles.—Ax, pick, sledge, hammer, rake, brush, broom, and small tool handles, table of prices per M:

Woods.	Lowest.	Highest.	Average.	States.
White ash	$14	$35	$21	New England, New York, and Ohio.
White birch	15	35	22	New England.
Bass-wood	8	18	14	Connecticut, Ohio, Pennsylvania.
Hickory	10	50	29	New England, Ohio, Pennsylvania.
Maple (hard)	8	35	17	New England and Middle States.
White oak	25	50	35	New England.
Poplar	18	25	21	New England.

Not classified in above: beech, $15, Ohio and Massachusetts; cherry, $10 to $20, New York; walnut, $100.

Agricultural implements.—Including churns, pumps, windmills, &c.:

Woods.	Lowest.	Highest.	Average.	States.
White ash	$20	$30	$24	New England, Ohio, Wisconsin.
Oak, red and white	16	24	22	Vermont, Ohio, Wisconsin, and Michigan.
Poplar	22	32	26	New England, Ohio, Wisconsin.
Maple	15	18	16	Massachusetts, Vermont, Michigan, Ohio.

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Bass, $10 to $5; hickory, $22 to 25; white pine, $25; yellow pine, $30.

Carpenters's tools, wood screws, &c.—Beech, $8 to $30; white birch, $8 to $35; hickory, $50 to $100; maple, $8 to $35; black cherry, $40. New England States.

Bobbins, spools, &c.—Beech, $18; birch, $8 to $20; bass, $20.

Surveying instruments.—Woods necessarily purchased in comparatively small quantities. Beech, $40; cherry, $90; maple, $40; white pine, $50.

Wood type.—Maple, $30; cherry, $30 to $60.

Shoe pegs, lasts, &c.—White and silver birch, $15; maple, $15 to $40; persimmon, $25 to $65. New England States, New York, and Ohio.

Baskets.—Ash, $35; bass-wood, $15.

Cooperage.—Replies from New England, Middle and Western States.

Woods.	Lowest.	Highest.	Average.
White ash	$5 00	$40 00	$13 00
Oak	5 00	60 00	15 00
Spruce	2 00	20 00	10 00
Pine, white	5 00	34 00	11 00
Bass-wood	4 00	10 00	7 50
Elm	4 00	10 00	6 50

Maple, average, $25; cedar, $26; cypress, $33; chestnut, $20; beech, $10; birch, $11; sycamore, $10; poplar, $8; hemlock, $6; cotton-wood, $4; red cedar, $10.

Tobacco-boxes, &c.—Poplar for cigar-boxes, $9; sycamore, $22.

Packing-boxes.—White pine, $11; spruce, $10; bass, $12.

Turned goods.—Birch, $5 to $30, average, $15; maple, $12.

Measures, cheese-boxes, barrel-hoops, drum-hoops, &c.—White ash, $10 to $25, average, $16; beech, $11; oak, $16; elm, $11.

Furniture.

Woods.	Lowest.	Highest.	Average.	States.
Black walnut	$15 00	$100 00	$50 00	Vermont, New York, Ohio, Minnesota, Indiana, Wisconsin, Michigan, and Illinois.
White ash	10 00	45 00	24 00	Vermont, Massachusetts, New York, Ohio, Indiana, Illinois.
Beech	7 00	20 00	13 00	New England and New York.
Birch	10 00	22 00	17 00	New England, New York. Indiana, Wisconsin.
Bass-wood	10 00	25 00	16 00	New England, Middle and Western States.
Cherry	25 00	85 00	53 00	New York, Ohio, Indiana, Illinois, Minnesota, Michigan.
Elm	12 00	20 00	18 00	Vermont, New York, Indiana, Illinois.
Maple	9 00	22 00	14 00	New England and Western States.
Oak, white	16 00	40 00	26 00	New York and Western States.
Pine, white	9 00	50 00	21 00	New England and Minnesota.
Poplar	8 00	35 00	23 00	New England and Western States.

Chestnut, $15; spruce, $15; yellow pine, $12; butternut, $30; gum, $50; sycamore, $50.

Wooden ware—Butter-molds. trays, bowls, clothes-pins, and similar articles. Prices average as follows for lumber used, per 1,000 feet: Maple, $7 to $10; birch, $8; cotton-wood, $6 to $8; elm, $4 to $6; sycamore, $5. New York and Ohio chiefly.

Pianos and musical instruments.—About the same average as prices given under the head of furniture.

Toys, building-blocks, &c.—Ash, $25; birch, $25; bass-wood, $14 to $30; cherry, $25 to $35; chestnut, $12 to $20; maple, $16 to $28; oak, $18; poplar, $18; white pine, $40; spruce, $16.

Object forms, geometric solids, &c.—Hard woods average $40 per M; soft woods, $35.

Lead pencils.—Average cost of cedar, 50 cents per cubic foot.

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INCREASE IN COST OF LUMBER IN TEN YEARS.

An attempt was made to ascertain the percentage of increase in cost of lumber of all kinds in ten years. The question was ignored by many manufacturers, only about one-half of those replying to the circulars giving answers. While some of the returns indicate that in certain sections, or with particular industries, lumber is cheaper than ten years ago, by far the greater number of answers to the questions show a decided increase in cost. The results are as follows:

Building lumber, &c.—About 50 per cent. of the replies show an average increase of 18 per cent., the range being from 10 to 25 per cent. on all kinds of lumber.

Ship timber and other used in ship-building industries.—Only 30 per cent. of replies; range 5 to 30 per cent.; average increase about 15 per cent.

Carriage-building.—Replies given in two-fifths of the returns, with an average of 20 per cent. increase, the range being from 10 to 30 per cent.

Several large manufactories reporting that there had been no material increase in cost of carriage lumber in ten years, a letter of inquiry was directed to one of the principal manufacturing concerns of the country, asking for opinions as to causes of the same. The following is, in substance, the reply received:

"The principal reasons why the prices of lumber used in carriage-making have not advanced materially in the past ten years, we think are:

"(1) There has been a general shrinking of values in that time, taking gold as the standard; (2) new sources of supply have been made available by the opening of new lines of transportation; (3) the demand in times like the present is largely for cheap goods, and the supply of low-grade timber is abundant and will be so for many years to come. Should business revive we think there would be a quick and decided advance in the best grades, and even as matters now stand we find it difficult to get a supply of good stock of some kinds; yet the condition of trade is such that we cannot safely increase cost."

Tool-handles.—Answers to question in one-third of the replies indicating a general average of 20 to 25 per cent. increase in cost of hickory chiefly, one ax-handle concern in Ohio reporting 50 per cent.

Wooden tools.—About the same as the above.

Agricultural implements.—About 50 per cent. of replies average increase 12 per cent., range 10 to 20 per cent.

Cooperage.—Thirty per cent. of replies show increase in cost, range 5 to 25, average 17 per cent. One concern in Maine reports 40 per cent. increase in cost of oak, and one concern in Ohio reports a decrease of 20 per cent. in pine.

Hoops and other split and shaved woods.—Only two replies, indicating increase of 20 per cent., the question being ignored in all others.

Turned goods.—Increase of 10 per cent. in cost of white birch indicated in Maine. Question generally ignored.

Veneers, excelsior, &c.—Circulars generally report an increase of 10 to 30 per cent.; average 21 per cent.

Packing and other boxes, including tobacco.—No increase indicated.

Furniture.—Fifty per cent. of replies indicate an average increase of 17 per cent. Twelve per cent. of replies indicate a decrease of about 15 per cent.

Pianos.—A very few returns indicate an increase of 20 to 25 per cent. on special woods, walnut being particularly named.

Toys.—A leading toy-manufacturing concern in New England reports an average increase of 10 per cent., this being the only reply to the question.

Other industries are passed over, the replies furnishing insufficient data for even approximate averages of percentages. Supposably little or no increase in cost of lumber used.

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APPENDIX II.

GENERAL STATISTICS OF WOOD-WORKING INDUSTRIES.

These figures are presented to illustrate the enormous demand made upon the forest of the United States in a single year by the wood-working industries, or for lumber used in construction, for fuel, &c., to which is appended value of timber lost by forest fires.

TABLE A.—*Showing extent of wood-working industries in the United States, value of product &c. From United States census of* 1880.

Industry.	Establishments.	Capital.	Hands employed.	Wages per year.	Value of products.
Agricultural implements	1,943	$62,109,668	39,580	$15,359,610	$68,640,486
Artificial limbs	33	82,600	72	43,833	137,024
Baskets and willow-ware	304	1,852,917	3,119	657,405	1,992,851
Boxes, packing	602	5,304,212	7,722	2,769,135	12,687,068
Carpentering	9,184	19,541,358	54,138	24,582,077	94,152,139
Carriages and wagons	3,841	37,973,493	45,394	18,988,615	64,951,617
Cooperage	3,898	12,178,726	25,973	8,992,603	33,714,770
Furniture, including chairs	5,227	44,946,128	59,304	23,695,080	77,845,725
Handles of wood	206	1,032,090	1,575	436,664	1,656,698
Kindling-wood	213	1,018,490	1,443	526,861	2,480,953
Lasts and boot-trees	62	477,692	537	308,975	765,296
Picture-frames, &c	645	4,437,666	6,183	2,471,105	9,596,219
Matches	37	2,114,850	2,219	535,911	4,668,446
Organ manufacture	171	3,922,338	4,262	2,142,539	6,136,472
Piano manufacture	174	9,869,577	6,575	4,663,193	12,264,521
Pencils	4	341,597	399	102,115	879,427
Refrigerators	71	727,220	1,053	423,680	1,739,731
Sash, doors, and blinds	1,288	20,457,670	21,898	8,540,930	36,621,325
Sewing-machine cases	18	741,300	1,422	683,338	2,064,837
Shingles, split	45	17,770	193	11,394	47,952
Ship-building	2,188	20,979,874	21,345	12,713,813	36,800,327
Umbrellas and canes	172	2,658,725	3,608	1,158,682	6,917,463
Veneering	5	261,500	141	35,730	292,200
Wheelbarrows	22	266,200	239	72,489	227,392
Wheelwrighting	10,701	10,641,080	16,108	5,074,799	18,892,858
Windmills	69	697,100	596	244,197	1,010,542
Wood pulp	50	1,898,450	1,209	444,778	2,256,946
Wood, carved, &c	710	3,450,710	5,665	2,148,914	6,770,119
Wooden ware	287	3,606,794	5,033	1,539,571	5,235,474

TABLE B.—*Table showing product and values of sawed lumber. From census of* 1880.

Lumber	feet	18,091,356,000
Laths	number	1,761,788,000
Shingles	do	5,555,046,000
Staves	do	1,248,226,000
Sets of headings	do	146,523,000
Spool and bobbin stock	feet	34,076,000
Total value		$233,268,729

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TABLE C.—*Table showing quantity of lumber used in ship-building in* 1880. *From tenth census.*

	Feet.
Hard pine	39,327,372
White pine	47,506,048
White oak	69,701,360
Total lumber, including other kinds	179,873,966
Knees	97,192

TABLE D.—*Value of timber used as fuel in the census year. From Forestry Report of Prof. C. S. Sargent.*

For domestic purposes (estimated)	$306,950,040
Used by railroads	5,126,714
Used by steamboats	1,812,083
In manufactures and mining	8,073,420
As charcoal (in part)	4,755,420
Total	$326,717,793

TABLE E.—*Miscellaneous uses of woods, with values of product (from same source as above.)*

Railroad-ties	$9,806,247
Railroad-fence posts	180,000
Hoop-poles	1,947,316

To the above should be added the value of tan-bark, there being used in the census year 1,101,526 tons of hemlock bark and 353,245 tons of white-oak bark.

Forest fires (census year).—Areas burned over in acres, 10,274,089; value, $25,462,250.

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APPENDIX III.

PROSPECTS OF FUTURE SUPPLY AND NEEDS OF LEGISLATION.

The following views of manufacturers on the general aspects of the forestry question, prospects of future supply of kinds of timber most used by them, and opinions concerning legislation are presented in the form of brief extracts:

Burlington, Vt.—Will be exhausted in twenty-five or thirty years at present rate of consumption. Native woods should be planted, and forests protected.

Mobile, Ala.—As far as the Gulf States are concerned, the pine would last the saw-mills for perhaps a hundred years to come; but the timber will, I think, be practically gone in thirty years on account of the destruction wrought in the manufacture of turpentine and rosin. The work should be regulated by law.

Wilmington, N. C.—Twenty years ago we thought the end was in sight; since then we have had a regular supply of twenty or thirty millions annually. The quality is, of course, not so good, as much of the timber is from young trees with more sap than heart. Yet continual avenues are opened by the railroads, and the supply is equal to the demand.

Marshfield, Vt.—I am directly on the line of railroad, and cut nothing but the largest timber, leaving all of the small to grow up, which will be fit to cut in twenty or twenty-five years. It will surely pay to grow timber on or near lines of railroads better than any other crop.

Sandgate, Vt.—The consumption of timber is much greater than its growth.

Chicago, Ill.—Fashion controls the use of wood in our line (church furniture, wood mantels, &c.). The color and grain of any wood can be imitated on any other by skillful staining and graining beyond the ability of any one to detect the difference. We make about all of our cherry work from red birch. It is just as good in every respect. We sell it for cherry, and it is scarcely ever questioned and never rejected, excepting in special cases where the name is considered important.

If there were not another foot of black walnut in the country, the gum would supply its place fully. It seems to us that use of veneers is on the increase. We are constantly using it more and more for all plane surfaces. Facilities of transportation are at present of much more value than the woods. Cases occur where the cost of carrying goods over railroads which monopolize the trade is greater than charges over competing lines by the whole cost of the wood.

Lowell, Mass.—Supply being rapidly exhausted; growing poor in quality and smaller in size every year.

Addison, N. Y.—The supply of pine will last about twenty years.

New York City (manufacture of floorings).—Unless some more effective mode is soon adopted to protect the forests and incentive offered to plant, we shall in a short time have to depend upon other countries for our supplies.

Cincinnati, Ohio.—Ship-timber is becoming very scarce, and in the course of fifteen to twenty years boats must be built of other material.

Acushnet, Mass.—The prospect of future supply of cedar for boat-building is not very bright. Pine timber is the most valuable of any wood that grows about here.

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Those that have any large enough for box-boards are cutting it off and selling it to the millers for $6 a cord; but it is getting scarce; there are only small lots to be obtained at any one place. Our supply of yellow oak from Connecticut becomes poorer and poorer every year. Those who send it here tell us that it is getting scarce, it being hard work to get such as will answer. I think there is need of legislation on this question. I suggest offering a bounty for setting trees for timber, or something of the kind, and making laws to encourage those who have suitable land to set trees. There are thousands of acres of land in this State that are covered with bushes and briers which might be converted into valuable timber land with but little expense. Within 4 miles of this place is a 5-acre lot which the owner set to white pine about twenty-eight years ago. The trees are now 15 inches in circumference and large enough to cut for box-boards. The investment has paid him 10 per cent. interest, he thinks.

Newburyport, Mass.—All kinds of timber are growing scarce. I think there should be a law to regulate the cutting of sapling pine for shoe and other box boards.

In consequence of the tendency to use iron for the construction of the hulls of ships and steamers, there is but little demand for oak ship-timber. Hard pine from the South is annually increasing in price, but is mainly used for house-building and bridge-building purposes. The supply is being rapidly reduced by the enormous consumption.

Brewer, Me.—No legislation needed except to be more careful of pine. Fires have killed more lumber in this State than the ax. Pine and spruce grow very fast here. Have known of good sized pine logs being cut in twenty-five years after a fire had burned off the tract.

New York City.—Timber (for car-building) is rapidly diminishing. We find that Western consumers are competing with us in Michigan, Indiana, Kentucky, and Tennessee, and it is not apparent where the supply for the East will next be obtained. Canada lumber should be freely admitted to the United States.

Canton, N. Y.—The State should own the lands on the headwaters of our rivers and should control the cutting of timber.

Chicago, Ill.—There is cedar enough to last for one hundred years, but it will be very expensive in twenty-five years from now. All railroads building west of Mississippi River, north of Missouri, and west of Missouri, south of Iowa, should have been forced to set aside two sections of land for each 10 miles of railroad built, for tree culture.

New Haven, Conn.—A carriage manufacturer writes: "There is no question but what there will be a very small supply in the near future of the best grades of hickory and ash. They are very scarce at the present time, and we would advocate a law which should prohibit cutting either hickory or ash trees under a certain size, and also pay a subsidy to farmers who will plant a certain number of these trees at certain distances apart annually."

Pequa, Ohio.—Think twenty-five years, at the farthest, will exhaust all the hickory in the country.

Mansfield, Ohio.—Regarding hickory, think the supply will be exhausted in twenty years.

A Connecticut wheel manufacturer says: "From the fact that wheel-makers are getting so they scarcely consider the distance a supply of hickory may be removed as an obstacle to its purchase, we consider it certain that ten years will develop either one of these states of affairs: Either some other wood will be used out of which wheels will be made, or some other kind of wheel, made of metal, will be introduced. We consider the latter the most liable to be brought about."

West Chester, Pa.—We find that hickory rim stuff of best quality, which has been found chiefly in a section within 100 miles of tidewater, is becoming more and more difficult to obtain, as it grows only on ground which is valuable for agricultural purposes, and which once cleared off is not allowed to grow up in timber again. The

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other kinds of woods used by us are common to a much greater area, and we find no difficulty in procuring all we need at prices as low or lower than those prevailing in the past, as the extension of railroads into new territory and decreased rates of freight enable us to draw from a much larger extent of country. Our observations lead us to believe that the amount of timber going to waste in the United States is greater than the amount made use of, and that while this continues to be the case the cultivation of timber cannot be a financial success in other than exceptional locations. We think it might be well for the Government to establish experimental plantations in order to learn what could be done, with the best manner of doing it, and the probable cost, but doubt the propriety of going further than this at present.

New Lexington, Ohio.—The forests of this country are being exhausted very rapidly, so much so in fact that it is almost an impossibility to obtain a first-class spoke in oak. Second growths are almost out of the question. The timber question of the country is a very important one to us now.

Delphos, Ohio.—Timber for our line (carriage manufacture) will be cleared out in this section within the next ten years.

Fostoria, Ohio.—Twenty-five years ago this Northwestern Ohio was one of the best timbered countries that could be found in the United States; to-day the class of timber that enters into the construction of wagons and carriages is becoming scarce and is in very great demand. Where the supply is to come from fifteen or twenty years hence should be a matter of serious consideration. That there is great need of legislation on that question there is no room to doubt.

A Philadelphia carriage manufacturer writes: "There is no question but that the timber is being cut faster than it grows. The amount consumed by the railroads for ties, in addition to the increased demand from abroad and the regular home consumption (constantly increasing with the increase of population), must force upon the country the necessity of legislation similar to that existing in Sweden, Norway, and Germany."

Another, from New Haven, says: "Hickory, ash, and white wood are being used up much faster than they can grow, and in a very few years will be very scarce and of poor quality. Then it will be regretted that we did not take measures to insure a future supply."

Bristol, Conn.—If I were a young man I would put one-third of my 30 acres in black walnut and wait for it to grow; would reap a rich reward in day's decline.

Greensborough, N. C.—I think that our choice hickory at the present rate of consumption will be pretty well exhausted in twenty-five years from now. The white-oak supply will last much longer from its greater abundance, but it is rapidly being cut, and both timbers, being of comparatively slow growth, will be scarce and valuable in the near future. I cannot see that any legislation will help the matter.

New Haven, Conn. (*carriage wood-work*).—The forestry question is one of the most important economic questions of this generation, and should receive far more attention from our legislators than it does. All that can be done in regard to old-growth ash and poplar is to protect the supply we now have; it can never be replaced. A supply of second-growth ash and hickory may be obtained by cultivation and the protection of young saplings, and a supply may be obtained in twenty-five years.

What laws are required we cannot say, but we think that something should be done to save the saplings in the States of New Jersey and Connecticut. In forty years these States could furnish an immense amount of the very best of hickory timber, if the destructive waste of the young trees for the purpose of getting hoop-poles could be stopped; but how to stop it is an unsolved problem; yet it must be stopped, or we shall never have any good hickory in these States, for these hoop-pole cutters select the very best for their use and let the poor ones stand. This course must be reversed, but how to do it is a problem we cannot solve. We do not see how law can prevent a man from cutting what timber he chooses on his own land; and as but few men care

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anything about future generations, the mass of the people will act as they think best for themselves while living.

Dayton, Ohio.—At the present rate of unnecessary slaughter of timber, the country will be denuded in twenty-five years (hard maple). The larger forests are purchased and cleared for the profit there is in the timber. The farmer who has 100 acres of land, with 15 to 20 of it forest, says: "The taxes are so great, and the yield so slight from his timber land, he is obliged to reduce the area," and so the forest must go. Removal of tax from all timber land would, in a large degree, remove the necessity for cutting out the same on the cleared farms, as well an in the extensive forests.

Norwich, Conn.—Of rock-maple there is a great abundance, but white pine is fast going from the face of the earth, and means should be adopted to grow it anew, as it is the most valuable of all lumber.

Racine, Wis. (*agricultural implements*).—The matter of future lumber supplies is getting to be a serious matter. The better grades of lumber are in good demand, the quality of lumber growing poorer each year; still we manage to get all we require from year to year by paying a fair price, subject to our own inspection.

Athens, Vt.—White ash is becoming very scarce in this section.

Stamford, Vt.—Our timber land is rough, mountainous, rocky, and wet, not fit for cultivation, and after the old timber is cut off it immediately grows up to brush and second-growth, and there is more territory now covered with timber and second growth in this vicinity than there was twenty years ago.

Saint Johnsbury, Vt.—Good supply (spruce and birch) in this section for the next fifty years.

Richmond, Va.—The lumber I use (sycamore) is scattered throughout the States, differing in quality, with advantage in favor of the more northerly and colder climates. Is probably being cut for tobacco-box manufacture and for cheap dwellings, at the rate of 100,000,000 feet annually.

Benson, Vt.—Good timber will be very scarce in twenty-five years.

Delphos, Ohio.—At present consumption of timber I don't think that linn wood can be obtained for manufacturing purposes in Allen, Van Wert, Putnam, and Paulding counties, in this State, in ten years. (Excelsior manufacture.)

Lebanon, Conn.—A prominent handle manufacturer writes: "The question of a future timber supply is an interesting one, both to the manufacturer and to the political economist. Notwithstanding the fact that there has been so little advance in the price of sawed lumber in the past ten years, it is the opinion of many who are well qualified to judge that there must be a material advance in the near future. Several causes have operated to depress the price of lumber at the present time. First might be mentioned a general stagnation of business and almost universal depreciation of values in all manufactured articles. The advent of the portable saw-mill has been an important factor to be considered, not only with respect to the present market value of lumber, but also as affecting the future supply. While this institution was hardly known in this section ten years ago, there is now scarcely a town in this vicinity which has not felt its influence. The effect of setting up such a mill in any section is to make certain kinds and qualities of lumber cheap in that vicinity as long as the supply of standing timber lasts. When this is exhausted, the mill is moved a few miles perhaps, another lot of cheap lumber thrown upon the market, more hillsides denuded, and so the process goes forward as long as there is timber large enough to make railroad ties, and in sufficient quantity to pay for setting up a mill. And this leads me to speak of the vast consumption of timber by the railroads of the country, in ties, bridges, &c. No person who has not taken pains to inform himself upon this point would have any idea how vast this consumption is; and until some better or cheaper material is found as a substitute, our timber supply will be heavily taxed to supply this ever increasing demand.

But it is not merely the legitimate consumption of timber by the railroads which causes apprehension in the minds of those interested in the supply for the future. One

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would suppose that these corporations would be actuated by a feeling of self-interest to use all reasonable care in preventing the destruction of standing timber contiguous to their lines of road. This, however, does not seem to be the case. Forest fires in the vicinity of railroads have become so common as to cause a general feeling of insecurity among holders of such property, and a disposition to cut off or sell at the very first opportunity.

In view of the foregoing facts, it would seem desirable that we should have such legislation as will encourage the cultivation of young timber. Whether this can in some degree be accomplished by exempting lands devoted to this purpose from taxation for a term of years, may be an open question; but it would seem that before it can be made a very great inducement for people to invest largely in this kind of property, some method must be devised by which greater immunity may be enjoyed from the reckless destruction to which such property is particularly exposed.

Norwich, Conn.—The northern white birch is a quick-growth wood; probably 20 years would grow wood large enough to cut. Inhabitants of the vicinity where this wood is cut say that it cannot be exhausted this century sure, and do not think it ever will be.

Foxcroft, Me.—This is a matter of vital importance, and should receive special attention from the Government with the view not only of preventing wasteful destruction of our present forest limits, but in every possible way encourage the planting of additional area with such timber as will be of the greatest value when grown. In regard to the special timber I use (white birch), I have no doubt that in the near future all the large growth will be exhausted, so that instead of using trees so large that the wood has to be sawed into squares to reduce it to size, small trees will be made use of, of a size suitable for a single spool; the wood being put in the form of poles when cut, so that the spools will be made from round poles. The supply of this wood, that is, white-birch wood, growing in this way and used as soon as large enough, may be considered inexhaustible, as it grows to such a size in a very short time, and when the necessity occurs it may be cultivated for these special purposes. In view of the foregoing, I do not see as white birch requires any special legislation to protect or to provide for a future supply of timber for spools, &c.

In this connection, I would add that although white birch is the only timber used in this country for spools it is not because other kinds of wood cannot be, but because owing to the peculiar quality of white birch it can be worked with greater economy than any other; so that if the very unlikely thing should happen that we should not have sufficient supply of it, we should not be deprived of the articles now made from it. We should still have them, but at an increased cost, because made from wood more difficult to work.

Woonsocket, R. I.—Think there ought to be legislation relative to cutting our best forest trees. Maple is growing very scarce, and price will in five years be much higher. We find it hard to obtain first quality. The white-birch lumber is also getting so scarce that Canadian parties can ship to many points in our country cheaper than native wood can be purchased. You see by the answer 6*b*, that the price has diminished in ten years. This is caused by competition and by improved logging machinery, and not because the wood is as plentiful. For the same reason the cost of all goods (bobbins, spools, &c.), has decreased 33 per cent. in the same time.

Buckfield, Me.—In this section of Oxford County, I think the yearly growth exceeds the yearly consumption of native woods. Ten acres of waste land are growing up to wood when there is one cleared of wood. Maine is a wood-growing State. There are ten thousand of pine now to one thousand 50 years ago. I have been here 65 years, and know whereof I affirm.

Columbus Grove, Ohio.—The hickory is rapidly disappearing, and constantly increasing in value.

Deep River, Conn.—The timber supply in our vicinity is fast passing away, and can last but a few years longer. We can to-day bring maple lumber from Vermont to our

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factory as cheaply as we can buy at the nearest mill. Small portable mills, working on railroad ties and timber, waste more timber than they sell, and are a curse to the country.

Red House, N. Y.—Ash timber cannot last over five years in this part of the country.

New Portland, Me.—Ash lumber is more plenty here now than thirty years ago. I think the white birch is fast diminishing.

Clinton, Conn.—It is a pity that the timber of this section is so nearly gone. There is no place, I believe, on the globe where hickory and oak of as good quality grows as on this coast line, from Maine to South Carolina. Connecticut hickory has always taken in the market preferably to any other.

Hartsburg, Ohio (*ax-handle manufacturer*).—I believe within 20 years the supply will be so nearly exhausted, at least in Ohio, that there will be no factories running in the State.

Hinsdale, Mass. (*ash baskets*).—Wood of many kinds is growing here faster than consumed. There is a scarcity of white ash just now, but there are quantities coming into the market in fifteen or twenty years. The Boston and Albany Railroad took large quantities of wood for many years. So that the wood is, much of it, small (twenty-years' growth), but since the use of coal the consumption of wood is comparatively small and the hills are being covered again.

New London, Ohio.—The writer has been engaged in the timber business for twenty-one years. The larger portion of the time was in buying and manufacturing timber for wagons and carriages, bending, &c. His experience in this section was as follows: From 1863 to 1873 forest hickory and oak were easier to obtain each year and about uniform in price; and from 1874 to 1884 have been continually harder to obtain and gradually increasing in price. But second-growth is much easier to obtain than ten years ago. All of these together with many other observations go to show that in a very few years good hickory, oak, and ash timber in this country will be hard to get for wagon and carriage work, unless some legislation be made to compel or induce land owners to replant a portion of their land. We do not think a law to compel owners of timber land to retain a small portion of same intact would be of any avail, unless about 100 or more acres be left in a body, as the good timber—which is always the tallest trees—will very soon begin to show the effect of the winds and storms, from which it has heretofore been protected by surrounding forests, &c. But timber planted and raised in the open air and sunshine, and cultivated, becomes very hardy and grows very rapidly. For example, a growth of three-eighths to one-half inch on small hickory or oak trees exposed to sunshine is not at all uncommon; consequently a thrifty tree will increase its diameter from three-fourths to one inch a year, and a stick 10 inches in diameter will work very well into spokes, felloes, shafts, &c. But five years more, or 5 inches more, on the outside of the 10-inch stick more than doubles the quantity of marketable timber. Hence in twenty years we might have very good timber for work requiring strong timber. Nearly all the second-growth hickory, ash, and oak which has been cut in this section within the past four years (and which is no very small amount) has grown within the last ten or fifteen years. Therefore we are favorable to such legislation as will bring about such results.

Minneapolis, Minn.—A prominent barrel company replies as follows: It is difficult to give an intelligent opinion on this question. Bass-wood, being of rapid growth and limited consumption, will probably last for generations. Red oak is becoming scarcer each year, and unless some other wood is used more freely for flour-barrel staves, the supply will doubtless be exhausted within the next fifteen years. I refer to the growth in this State, Wisconsin, and Michigan. It would seem that the same reasoning would apply to white oak, which is used largely for car material, the only exception being car sills, 30 feet long and upwards, which are now made somewhat of Norway pine, owing to the great expense of long oak (about double the price of timbers 20 feet long and under). But white oak has declined in price very sharply during the past two years. New lines of road have been opened through the timber belts

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of Wisconsin, and small portable saw-mills used largely for getting out hard wood. A locality being stripped of desirable timber, the mill is moved at small expense to a new locality. When timber on short hauls is exhausted, which must be in the course of a few years, white oak must advance rapidly in price, and the supply will probably be then exhausted in the course of twenty years. No legislation is necessary for the protection of this timber, as land owners are fully aware of its value. Elm makes a fairly good barrel and is used to some extent. The supply of this wood is very large.

Maple exists in large quantities, and since the Chicago, Saint Paul, Minneapolis and Omaha Railroad have abandoned the policy of burning wood on their engines the supply of maple in Wisconsin cannot be exhausted for fifty years.

East Jaffrey, N. H.—The supply of old-growth timber in this section is very nearly exhausted, but there is no prospect that the supply of soft-wood saplings will soon give out. There are more acres in this vicinity covered with pine at present than there were twenty years ago. Old farms are being deserted and are rapidly growing up with pine. The growth of hardwood trees, being much more slow, does not keep pace with the demand for them, but with improved processes of manufacture it may be found possible to utilize smaller and poorer stock so that the supply will not be exhausted in many years.

Middletown, N. Y.—An immense waste heretofore; greater saving recently manifested; with present demands, local supply good for thirty years. There will be need to cultivate cherry, which is one of the most valuable woods for furniture, household work, and better grades of manufactured goods. Careful legislation to encourage tree-growing and preserve forests a wise movement.

Menasha, Wis.—Michigan and Wisconsin pine timber will last twenty years.

From a Philadelphia cooperage concern: White cedar grows in the swamps and the land is valueless for anything else. As to future supply, may have trouble to procure supply sufficient for our use. Do not think legislation can help the matter of growth of white cedar, as when swamps are cut the cedar will grow again. There are still large swamps yet in South Jersey not cut, and the Dismal Swamp will serve for twenty years.

Naples, Me.—I think there is nearly as much small pine in this vicinity as there was when I commenced business here some twenty years ago. The first growth is gone long ago, but my idea is that people, at least in this vicinity, are taking very much better care of their small growth than formerly, and many lots of land well covered with small pine growth have been bought by men as investments, and can't be had or cut for any price. The same, I think, is the case to a great extent with the oak, although, that being a wood of slower growth, it will be many years before this will again become the oak section it once was. As far as my business is concerned, I apprehend no trouble in getting all the kinds I use, and sufficient quantities for at least my lifetime, with the exception of oak. As for legislation, I know of nothing that I think would much improve the situation in this section of Maine.

Northumberland, N. H.—The wood we use is a second growth, coming up where the original forests are cut off. It is quick-growing timber, and we find the supply equal to the demand in this section.

North Dansville, N. Y.—This branch of the business must go to the timber country; this portion of New York is virtually without timber. Some few, with foresight, save a piece from the ax, but many large farmers have no wood for fire. During the past twenty years there has been a determination to destroy all timber left, and the prospects for the future in this section will be dependent on railroads, as it is now, for our supply of timber. Michigan and Northern Pennsylvania now furnish us nearly all our timber. Regarding legislation, something should be done to defend our forests, and immediately. The march of the timber hunter is more to be dreaded than that of pestilence, and unless some legislation is done soon protecting what forests are in

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hands of the Government, or held by the different States, our children's children will be without timber or at the mercy of heartless monopolies.

Philadelphia, Pa.—The area of land producing white-cedar (or juniper) timber is very limited, being much in demand for the manufacture of cedar-ware, shingles, rail-road-ties, telegraph-arms, and fence-rails; the supply is yearly decreasing. Therefore the prospect for a satisfactory supply in the future is not assuring. This concern understands that "cedar ware" will not bear putting on the market on a basis of prices much beyond those now current, because it finds powerful competition from articles intended for similar purposes, manufactured from white pine, a wood which is procurable in much larger quantity than white cedar and at very much less price. In fact, at the present day, cedar ware cannot maintain itself in the face of such competition in the New England and Western States.

Chagrin Falls, Ohio.—Maple is growing in the immediate vicinity as fast as it is used. There was a large peg-factory here 12 or 15 years ago, and timber was higher then than now.

Fitchburg, Mass.—We think that if there is not some way devised to stop wasting timber, we shall soon be obliged to use foreign woods or stop manufacture. Three trees should be planted to every one cut down.

Dague, Ohio.—The timber we employ in our business (cotton-wood, elm, and sycamore) will be used up in five years, or nearly so, in the State of Ohio. There should be legislation to prevent the wanton destruction of first-growth timber by the saw-mill men. There are at least 40 saw-mills in Paulding County.

South Sterling, Pa.—The timber used here is fast disappearing; nearly as much has been destroyed by forest fires as has been manufactured, most of the large fires having been caused by sparks from passing locomotives. Each year great damage is done to timber from this source; if legislation can effect a remedy it should be enacted.

Middlefield, Conn.—A large manufacturing concern says: Supply gradually diminishing (birch, maple, and pine). Legislation encouraging planting and preservation of timber trees on waste or mountain land and fixing penalties for causing unnecessary fires, and for useless destruction of timber is desirable.

A Chicago furniture manufacturer writes: "We do not think that our forests will be depleted for a great many years to come as there is an immense lot of good lumber uncut in the different sections of our country, and the recent decline in the price of all hard woods seems to warrant this view. The rapid increase in the demand for foreign woods will also tend to preserve our stock of native woods, for some years at least. Nevertheless, our Government should encourage forestry, and especially the culture and growth of walnut, ash, oak, and other hard-wood lumber, beside pine and poplar. Farmers should be shown, through properly written and distributed circulars, what an immense profit the cultivation of timber, and especially black walnut, will yield. Seeds should be distributed, premiums offered, and such other inducements as may seem fit, to encourage and foster the growth of our forests. Schools of forestry might be established and maintained, and the legislatures of the different States should by law exempt such tracts of land as are set apart for new growth of timber from taxation for a term of years."

Robertsville, Conn.—The timber is wasted a great deal faster than it grows. Consequently it is only a question of time when the supply will be exhausted.

Another Chicago furniture-manufacturing company writes: Everybody seems to know that our forests and our resources in this line are nearly ruined already, but every one wishes only to enrich himself without regard to the future. We should have earnest legislation.

A Boston furniture company writes: "We think rigorous legislation is needed to save forests from waste, to encourage the planting of valuable woods, to set aside great naonal forest parks, and to provide for a forestry commission that will see that public forest lands are not plundered by rings and monopolies. As soon as there is a general re-

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vival of business, all the cabinet (native) woods we use will surely advance in price on account of growing scarcity."

Elliottsville, N. Y.—The timber of all kinds is rapidly disappearing, and it is only a question of time when all will have gone, and some varieties have nearly or all gone from this immediate vicinity, viz, ash, cherry, pine, and hemlock.

Grand Rapids, Mich.—The wholesale destruction of lumber should be counteracted, especially of hard-wood kinds, as it will take a long time to repair deficiencies by the growing of trees.

Milwaukee, Wis.—There is but one view or opinion as regards this subject, which is that the way of destruction of timber is carried too far already, and of course either by industrial impulse or enterprise, or by legislation, something must be done, at a very early day too.

Granville, Mass.—The timber is fast diminishing; the railroads are taking our most valuable timber for their ties; trees are cut when 10½ inches in diameter, and in a short time the old growth will be exhausted.

Dolgeville, N. Y.—In our State convict labor should be employed to make roads through the Adirondack region, a State forestry bureau should have stations all through the region to enforce forestry laws, of which the following are most needed: (1) Prevent the cutting of any trees less than 16 inches diameter at the butt; (2) Make stealing of logs or timber a criminal offense with severe punishment.

Franklin, N. H.—The kinds of wood we use (maple, cherry. ash, and birch) are becoming scarcer every year, and unless something is done to prevent waste it will in a very few years be difficult to get a supply.

Windsor Locks, Conn.—Every State should plant new forests and restrict cutting. German plan is a model. Congress ought to stop all cutting, except under restriction, on United States lands at headwaters of great rivers. States likewise. Without some restriction upon the ax, good woods will become extinct east of the Mississippi in 20 years; in New England, in 10 years. There is no more important question before the people than that of the preservation and regrowth of our forests. I believe that the conditions of human life are largely dependent upon the area of forest. The American people in their haste to be smart and rich are killing the fabled goose of golden eggs. Forests would rejuvenate old, sterile countries like Palestine. The absence of forests will rapidly destroy our soil and climatic benefits.

Beaver Falls, N. Y.—The prospect for a future supply of spruce in this country is not very encouraging. The trees are dying off quite rapidly, so that in a few years, with the natural demand, there must of necessity be a scarcity of spruce timber.

Danby, Vt.—The supply of timber in this section will soon be exhausted; in my opinion there will be but little timber standing in 1900.

Ewing, Mass.—There should be practical legislation to replace the wholesale slaughter of timber throughout the country.

TIMBER GROWING.

The following suggestions relative to timber culture are by W. W. Gilette, Bozrahville, Conn:

"Any one who attempts to raise crops from the soil soon learns, if he did not know before, how great an advantage it is that the soil should be adapted to the particular crop he wishes to cultivate. We hear farmers speak of certain fields as being good corn land, or good grass land, &c., and other things being equal he is most successful who studies to know what crops his lands are suited to, and regulates his practice accordingly.

"There is a great deal of land in Connecticut that may be said to be specially adapted to the cultivation of timber. We know this to be the case with regard to much of the land, from the fact that wood of some kind is the natural product of the soil, for if left to itself it rapidly grows up, it may be to chestnut, oak, hickory, or other valuable wood, or it may be to white birch, alder, poison sumac, or something

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else equally worthless. There is but little doubt that any land on which the latter kinds grow so spontaneously would, with a little care, produce some of the valuable varieties; for instance, land that seems too poor to bear anything but white birch might be induced instead to bear white pine, especially as this variety flourishes in very poor soil. In like manner the swamps which now abound in alder and sumac might be made to bear white cedar, or even pine, as is attested by the various denuded pine and cedar swamps in different parts of the State.

"One consideration worthy to be taken into account when we contemplate making plantations of timber is that the soil will not be exhausted by its growth as it is by many other crops. It is well known that trees derive a great part of their substance from the atmosphere and from water, the decaying leaves seeming to supply more fertilizing material to the soil than the roots extract from it, for who is not aware that our forest lands when cleared make excellent grass and grain lands until their fertility is exhausted by a process less in harmony with the operations of nature.

"But will it pay to cultivate timber? I answer, it might be questionable policy to put high-priced land to such use; but we have abundance of rocky lands and some not so rocky, which, on account of its distance from market or other causes, is not highly valuable for other purposes. The writer knows of an extensive tract, from which the timber had been removed, which was sold for a trifle over $3 per acre. The price of such lands in this section is generally about $5 or $6 per acre, unless the location is such as to make them desirable for other purposes. Suppose a tract of 100 acres could be bought for $6 per acre; there will be some expense for fencing and taxes, but cutting can be commenced within a few years, cutting only as may be necessary to give the best trees a fair chance to mature. Suppose that this tract is held for thirty-five years. The original purchase money, if it had been placed in a savings bank at present rates, would have only amounted to about $2,400 at the end of that time. There should be, however, upon this tract of 100 acres, if the timber is chestnut, at least 10,000 trees, from 15 to 18 inches in diameter. That this is a moderate estimate I think any one will allow who will take notice how thickly the trees stand in a well-wooded tract. It is to be remembered that the object is to develop the trunk rather than the top of the tree. If the object is to produce telegraph-poles or railroad-ties, the timber need not stand nearly so long; and chestnut timber has the advantage over many other varieties in that it so readily sprouts up from the old stumps and makes a rapid growth immediately after being cut; so that in the owner's lifetime he may possibly harvest two, or perhaps three, crops from the same land.

"And it would seem that there is nothing that can be raised from the soil that is more certain of being a marketable commodity than timber. If it is for railroad-ties and telegraph-poles, we know that the demand was never so great for these articles as at present, and that it is steadily increasing. If it is hard wood, suitable for carriage work or for handles, we know that hickory, oak, &c., raised upon Connecticut soil is sought after and valued much above that from the West or South.

"With regard to the amount of growth to allow before cutting timber, there is this to be observed: there is a proper time to cut a tree as there is a proper time to harvest a crop of corn or grass. If any one in cutting an aged tree will observe the concentric rings or grains, he will usually notice that there has been a period of rapid growth succeeded by a period of very slow growth; and in the case of a very aged tree it often happens that for the last score or more of years growth has come almost to a standstill, the grains being so fine as to show that the tree had but little mo[re] than held its own for a long time. Now, for all purposes requiring strength this fine-grained timber on the exterior of the tree, the growth of twenty or thirty years perhaps is about as nearly worthless as anything could well be. And when we consider that the interior of the tree which twenty or thirty years ago was vigorous and strong has been waiting all this time to be put to use until its vigor is exhausted and its strength decayed, it will be seen that it would have been better to cut the tree and obtain the benefit of its good qualities years ago. Much good ink has been

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wasted in deploring the destruction of our 'primeval forests,' but there are acres upon acres of trees in Connecticut that have been allowed to stand until their usefulness has been greatly impaired, sometimes destroyed, because we have not given sufficient attention to the proper time to harvest the crop after we had got it raised. Our hope of future timber supply does not lie in the direction of preserving the old, which cannot be preserved beyond certain limits, but in producing the new.

"When applied to carriage-work or handle-making, what is called timber of second growth is greatly to be preferred. The writer has cut trees for tool-handle manufacture whose concentric rings showed an age of 100 to 120 years, but it is rare that a tree of that age will make a handle that is worth putting into a tool. Trees from 12 to 15 inches in diameter are usually of much better quality.

"When it is desired to produce lumber for building purposes an older growth is no doubt desirable; but at present our building lumber is for the most part brought to us from beyond the limits of this State. Whether the time will ever come when it will be produced upon our own soil may be an open question. We do not possess the advantages in producing that class of lumber which we do in some other kinds. We cannot boast of producing a superior article as we can in kinds where great strength is required. But if the depletion of our Western forests is to be continued as it has been carried on for the last decade, the time may soon come when we shall be glad to avail ourselves of any resource for a supply."

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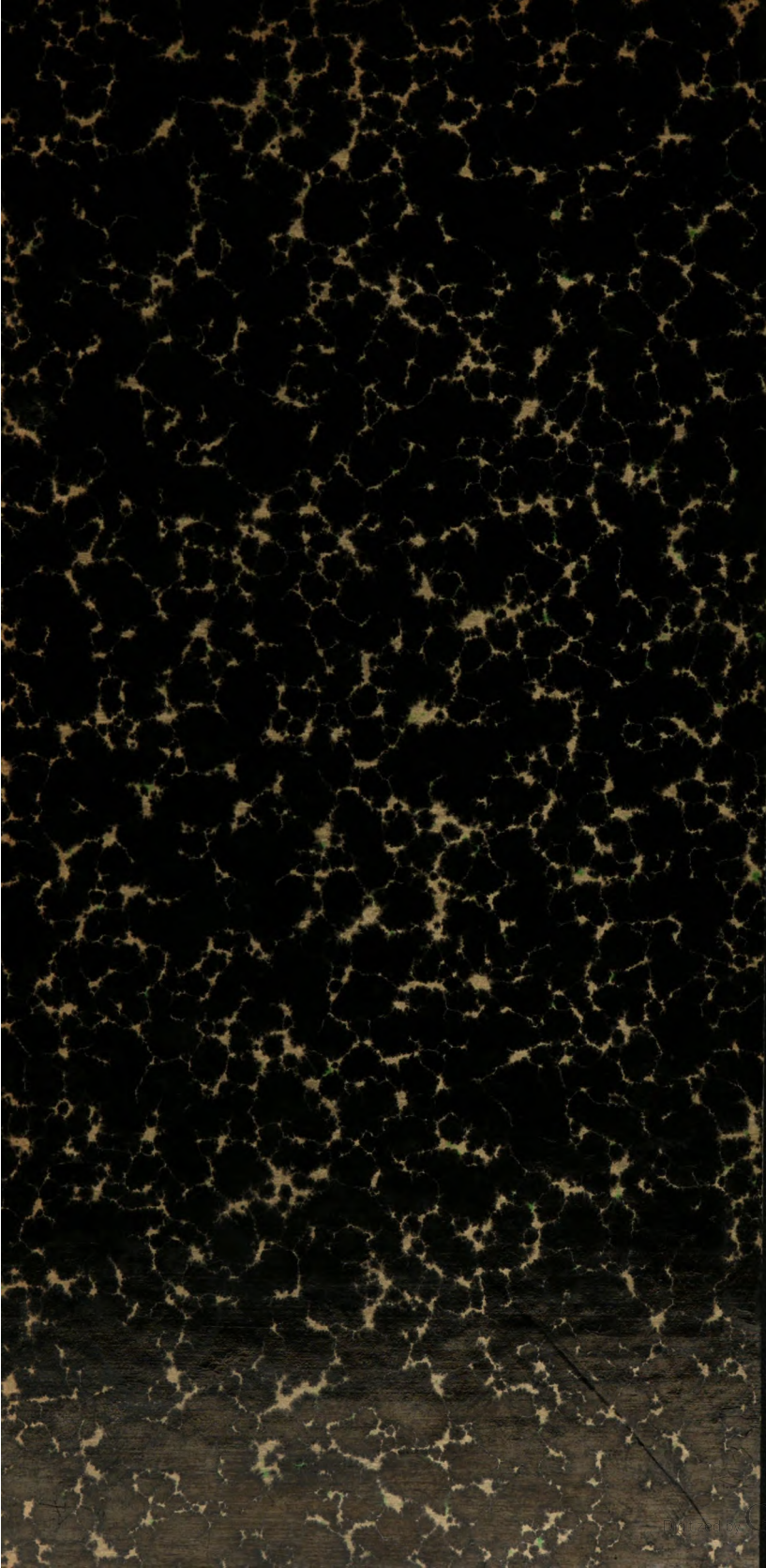
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